



# Burlington County Institute of Technology

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Medford Campus

## Career and Technical Programs

Career Cluster: *Architecture and Construction*

Program Name: *Electrician*

Program Title: *Electrical Technology*

CIP Code: 460302

Board Approval Date: January, 2024



# Program of Study

## → Grade 9

- ◆ Safety for Electricians
- ◆ Introduction to Electrical Circuits

## → Grade 10

- ◆ Electrical Theory
- ◆ Residential Wiring I
- ◆ Residential Wiring II

## → Grade 11

- ◆ Commercial Wiring I
- ◆ Commercial Wiring II
- ◆ AC Theory

## → Grade 12

- ◆ Industrial Motor Control I
- ◆ Industrial Motor Control II
- ◆ Industrial Motor Control III
- ◆ Green Technologies in Electric
- ◆ Cooperative Education



### → Program Descriptor

- ◆ Electrical Trades is designed to provide the student with the necessary entry-level skills to secure employment in a variety of trades within the electrical industry. These trades include electrical wire person, electrical repair person, outside electrician, shop electrician, and field electrician. Electrical safety and general industrial safety are stressed as primary and fundamental to each aspect of the trade for the protection of personnel and property. Course work will consist of classroom experience: lecture, demonstrations, audiovisual presentations, and written assignments. The course also provides hands-on experience through lab work, shop work, and field experiences. Assignments are student oriented and designed to meet individual student needs. Students will be evaluated on the basis of written work and practical performance.

### → Program Outcome

- ◆ Graduates of the Electrical program will possess the skills and competencies required for entry level employment as well as a foundation for pursuing post secondary education. Entry level employment could include residential, commercial, or industrial environments.

### → Work Based Learning Opportunities

- ◆ Simulated Workplace Environment: Students will work in all grades in a simulated environment for electrical technicians. Students will practice all skills related to residential, commercial, and industrial wiring.
- ◆ Hazardous Career Preparation: Students who choose to participate will be placed with a variety of employers such as OPEX and Radwell. Students will perform entry level tasks as assigned by their supervisor and will be assessed through program objectives.

### → Industry Valued Credentials

- ◆ OSHA 10



# Course Descriptions

## 1. Grade 9

- a. *Safety for Electricians:* This course includes Basic Safety, Introduction to Electrical, and Trade Math. This section explains the importance of safety in the Electrical field. Students will learn how to identify and follow safe work practices and procedures, and how to properly inspect and use safety equipment. This class also includes the most basic operating principles of electrical tools and systems. Lessons reinforce and extend the math skills the students' have learned in their academic math classes, which include calculations for units of measurement in both inch-pound and metric systems, and combined operations with whole numbers. This course includes the basic operating principles of electrical tools and systems.
- b. *Introduction to Electrical Circuits:* This course includes an introduction to hand tools, careers in the electrical field and DC theory part I. Students will be instructed in the identification, use, and care of hand tools. Developing the knowledge to properly choose and safely use hand tools is an essential part of the Electrical industry. Students will explore the many job titles related to electricity, and consider the aspects of business ownership. Lessons will describe the various types of DC sources, explain the relevant DC circuit terminology, demonstrate a series of basic DC circuit calculations by providing pertinent examples, introduce conventional and electron flow and voltage polarity as well as define Kirchhoff's Laws. Finally, lessons introduce students to DC circuit analysis and faults.

## 2. Grade 10

- a. *Electrical Theory:* This course includes DC Theory II, residential electric part I and National Electric Code part I. Students will be introduced to the concepts and requirements needed for a safe and hazard free installation, common electrical theory of DC circuits, and electrical safety as it relates to the electrical field. The course presents the basic concepts of direct and alternating current , how to apply Ohm's law to series, parallel, and series-parallel circuits, Kirchhoff's voltage and current laws , and the purpose of the



NEC®. Students will learn how to use the NEC® to find installation requirements for various electrical devices and wiring methods.

- b. *Residential Wiring I:* This course includes DC theory II , residential electric part I and National Electric Code part I. Students will study the basic concepts of direct and alternating current , how to apply Ohm's law to series, parallel, and series-parallel circuits, covers Kirchhoff's voltage and current laws ,describes the purpose of the NEC® and explains how to use it to find the installation requirements for various electrical devices and wiring methods. It also provides an overview of the National Electrical Manufacturers Association and Nationally Recognized Testing Laboratories. Electricians work with device boxes almost every day on every project, making a thorough understanding of the types of boxes available and their applications essential. This course describes the various types of boxes and explains how to calculate the NEC® fill requirements for outlet and junction boxes under 100 cubic inches (1,650 cubic centimeters), various types and uses of switches and receptacles, the proper installation of these devices and allowable ratings.. This section also introduces the fundamental concepts of the blueprint reading and scale drawings.
- c. *Residential Wiring Part II:* This course includes Residential Electric, and National Electric Code. This section presents the layout of a residential dwelling room by room as it pertains to code and requirements by industry standards. It discusses the various cables and devices used in electrical installations as it pertains to each room in a residential dwelling conductor types, cable markings, color codes, and ampacity derating. It also describes how to install conductors using fish tape and power conduit fishing systems.It discusses various types of raceway systems, along with their installation and NEC® requirements. It also describes the use of various conduit bodies, installation practices for various appliances and special circuits, rating systems for an OCPD. . DC Theory will continue to be used in the advancement to AC Theory and calculations of electrical circuits.

### 3. Grade 11

- a. *Commercial Wiring I:* This course will consist of interpreting electrical symbols used in construction drawings and several important factors that have to be considered in the selection of conductors like ampacity, conductor insulation in a commercial dwelling by code, and industry standards. Students will learn how to determine the required number of branch circuits for a set of loads and how to determine the correct rating for branch-circuit protective device. Included will be general requirements for wiring methods and materials for all wiring installations ( Chapter 3 NEC). The coursework also reinforces and



extends the math skills the students' have learned in their academic math classes, which include calculations on combined operations with percent and average.

- b. *Commercial Wiring II*: Students will learn fundamental concepts of appliance connections and code requirements that meet safety and industry standards. AC theory concepts are needed for applications and code calculations. This course includes installation of electric ranges, electric heating, and other electrical items that are required or needed in a commercial dwelling by code and industry standards. Troubleshooting skills will be taught for determining faulty or bad equipment. Meter applications are ongoing with AC Theory and code calculations. Coursework reinforces and extends the math skills the students' have learned in their academic math classes, which include calculations on combined operations with interest and ratio.
- c. *AC Theory*: This course will consist of applying practical training to the commercial and code requirements that are needed for industry. Students will learn proper tool use, installation of special cable, and special equipment to the standards required by code and local jurisdiction. Also covered are the basic concepts of alternating current (AC) electrical circuits and discusses the associated terminology. This class reinforces and extends the math skills the students' have learned in their academic math classes, which include calculations on powers and roots.

#### 4. Grade 12

- a. *Industrial Motor Controls I*: This course is a study of electric motors and control systems as applied to the industrial trades. Included in this course are basic control circuits and components, installation, wiring and wiring diagrams, troubleshooting of basic control circuits as well as the study of AC and DC drives. Students will study the operation of common control devices, how these components function and how they are used in motor control circuits, as well as the purpose and general principles of motor control. Course content includes the differences between manual and automatic motor control and considerations when installing motors or control equipment. Students will also learn the basic functions of a control system, symbols used in the drawing of schematic diagrams, and how to interpret the logic of a simple ladder diagram. This section reinforces and extends the math skills the students' have learned in their academic math classes, which include calculations on Length Measure.
- b. *Industrial Motor Controls II*: This course is a study of electric motors and control systems as applied to the industrial trades. Included in this course are maintenance, installation, wiring and wiring diagrams,



troubleshooting of motor controls as well as the study of AC and DC drives. Students will study terminology, symbols, definitions and diagramming. They will also learn to explain the operation of start-stop, forward-reverse-stop push button controls, how to draw a wiring diagram from a schematic diagram, and interlocking methods. This section will discuss how to connect a start-stop push button control circuit, a relay in a circuit, forward-reverse motor control circuit, jogging circuit, and a limit switch in a circuit. This section reinforces and extends the math skills the students' have learned in their academic math classes, which include calculations on Ratio and Proportion.

- c. *Industrial Motor Controls III*: This course is a study of electric motors and control systems as applied to the industrial trades. Included in this course are maintenance, installation, wiring and wiring diagrams, troubleshooting of motor controls as well as the study of AC and DC drives. This course will consist of terminology, symbols, definitions and diagramming. This course will also consist of the application of theory to hands-on learning of motor control in a real life setting. Students will learn steps for developing a motor control circuit and how to draw a control circuit using a list of requirements. This section reinforces and extends the math skills the students' have learned in their academic math classes, which include calculations on Formulas.
- d. *Green Technologies in Electric*: In Green Technologies in Electric, students will explore the intersection of sustainable practices and electrical systems. This high school-level class delves into innovative solutions that harness electrical technologies to promote environmental sustainability. Gain a deep understanding of renewable energy sources, energy-efficient technologies, and eco-friendly electrical practices. The curriculum integrates theoretical knowledge with hands-on projects, allowing students to design and implement green energy solutions. From solar power to energy-efficient lighting, this course equips students with the skills to contribute to a more sustainable future in the field of electrical technologies. Join us on a journey where technology meets environmental consciousness.
- e. *Cooperative Education (School-to-Work)*: This option is available to qualified students that have the ability to demonstrate their skills and proficiencies in a hands-on setting. Students will earn credit and income during their school to work experiences in their field of study. Students must provide their own transportation to avail themselves for this opportunity. This experience is coordinated by the school to work coordinator and has the recommendation of the electrical instructor.







# Curriculum Maps

Course: Safety

Unit: OSHA 10

Length: 1 Week

## Standards

- 9.3.12.AG-FD.1 Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.
- 9.3.12.AC-CST.5 Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.AR.2 Analyze the importance of health, safety and environmental management systems, policies and procedures common in arts, audio/video technology and communications activities and facilities.
- 9.3.12.ED.4 Evaluate and manage risks to safety, health and the environment in education and training settings.
- 9.3.HT-RFB.2 Demonstrate safety and sanitation procedures in food and beverage service facilities.
- 9.3.HU-ED.5 Evaluate safety and sanitation procedures associated with the early childhood education environment to assure compliance and prevent potential hazards.
- 9.3.LW.4 Conduct law, public safety, corrections and security work tasks in accordance with employee and employer rights, obligations and responsibilities, including occupational safety and health requirements.
- 9.3.LW-ENF.8 Explain the appropriate techniques for managing crisis situations in order to maintain public safety.
- 9.3.MN.3 Comply with federal, state and local regulations to ensure worker safety and health and environmental work practices.
- 9.3.MN-HSE.3 Demonstrates a safety inspection process to assure a healthy and safe manufacturing environment.
- 9.3.MN-HSE.5 Evaluate continuous improvement protocols and techniques in health, safety and/or environmental practices.
- 9.3.12.TD.5 Describe transportation, distribution and logistics employee rights and responsibilities and employers' obligations concerning occupational safety and health.



- 9.3.12.TD-HSE.1 Describe the health, safety and environmental rules and regulations in transportation, distribution and logistics workplaces.
- 9.3.12.TD-OPS.3 Comply with policies, laws and regulations in order to maintain safety, security and health and mitigate the economic and environmental risk of transportation operations.

### Essential Question(s)

- Why is it important to practice safety?
- What do safe practices look like in my industry?
- How can I keep myself and others safe?

### Content

- Walking working surfaces
- Emergency action plans
- Fire protection
- Electrocution hazards
- Personal protective equipment
- Hazard communication
- Materials handling, storage, use and disposal.

### Skills

- Explain why OSHA is important to workers.
- Explain workers rights under OSHA
- Discuss employer responsibilities under OSHA.
- Discuss the use of OSHA standards.
- Explain how OSHA inspections are conducted.
- Utilize helpful worker safety and health resources.
- Identify hazards in the workplace associated with walking and working surfaces.



- Identify best practices for eliminating or controlling hazards associated with walking and working surfaces in the workplace.
- Recognize employer requirements to protect workers from walking and working surface hazards.
- Recognize benefits of an Emergency Action Plan.
- Identify elements of the Fire Protection Plan.
- Identify conditions under which evacuation actions may be necessary in an emergency situation.
- Identify conditions under which shelter-in-place may be necessary in an emergency situation.
- Identify characteristics of an effective emergency escape route.
- Recognize the five types of fire extinguishers, including the types of fires they can extinguish.
- Review requirements for proper maintenance of portable fire extinguishers.
- Identify major electrical hazards.
- Describe types of electrical hazards.
- Describe electrical protection methods.
- Recognize employer requirements to protect workers from electrical hazards.
- Recall employer responsibilities toward affected employees regarding PPE.
- Identify when face and head protection should be used.
- Recall which types of hand and foot protection should be used in a specific situation.
- Recognize the differences between respirator types.
- Identify the differences between full-body protection levels.
- Identify the employer's responsibilities under the HCS, including training requirements.
- Identify components of a Hazard Communication program.
- Describe requirements of the different types of Hazard Communication labels.
- Locate pertinent information about chemicals on labels, including other forms of hazard communication, to ensure "right to understanding" provisions of GHS requirements.
- Identify types of material handling equipment.
- Describe hazards associated with material handling activities (e.g., storage, use, and disposal).
- Identify methods to prevent hazards associated with material handling equipment.
- Recognize employer requirements to protect workers from material handling hazards
- Identify the main causes of machinery accidents.



- Recognize basic machinery parts that expose workers to hazards.
- Recognize workplace situations involving machinery that requires guarding.
- Identify the requirements for safeguards.
- Identify types of machine guards including types of devices used to safeguard machines.
- Identify strategies to control chemical hazards.
- Identify strategies to control biological hazards.
- Identify strategies to control physical hazards.
- Identify strategies to control ergonomic hazards.
- Identify OSHA requirements pertaining to bloodborne pathogens.
- List the potential routes of exposure from bloodborne pathogens.
- Identify the risks associated with Human Immunodeficiency Virus (HIV), Hepatitis B, and Hepatitis C Virus.
- Identify methods of preventing transmission of bloodborne pathogens & managing occupational exposures.
- Restate methods of the safe disposal of sharps.
- Recount steps which should be taken in the event of an exposure to a potential bloodborne pathogen.
- Recognize risk factors associated with work-related musculoskeletal disorders (MSD)s.
- Identify good posture.
- Describe safe lifting techniques.
- Identify ergonomic control methods for eliminating/reducing work-related MSDs.
- Identify the number one cause of death for U.S. teens.
- List eight risk factors for young drivers.
- Identify the biggest risk factor for young drivers.
- Define distracted driving.
- Provide examples and/or causes of distracted driving.
- Identify the biggest risk factor for distracted driving
- Discuss the risk of having other young passengers in the car.
- List some actions employers should take to keep employees safe while driving.
- List some actions employees can take to safely drive on the job.
- Define the term violence.
- Recall who is at risk for encountering workplace violence.



- Describe workplace violence prevention strategies.
- Identify how to StartSafe and StaySafe to prevent or lessen workplace violence.
- Recognize the costs of workplace accidents.
- Recognize the benefits of implementing an effective safety and health program.
- Describe the elements of an effective safety and health program.
- Identify three methods to prevent workplace hazards.

### Assessments

- OSHA 10 Assessment and Certificate

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Course: CTE

Unit: Career Awareness

Length: Woven Throughout

### Standards

- 9.2.12.CAP.1: Analyze unemployment rates for workers with different levels of education and how the economic, social, and political conditions of a time period are affected by a recession.
- 9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.4: Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.



- 9.2.12.CAP.7: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
- 9.2.12.CAP.8: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
- 9.2.12.CAP.9: Locate information on working papers, what is required to obtain them, and who must sign them.
- 9.2.12.CAP.10: Identify strategies for reducing overall costs of postsecondary education (e.g., tuition assistance, loans, grants, scholarships, and student loans)
- 9.2.12.CAP.11: Demonstrate an understanding of Free Application for Federal Student Aid (FAFSA) requirements to apply for postsecondary education
- 9.2.12.CAP.12: Explain how compulsory government programs (e.g., Social Security, Medicare) provide insurance against some loss of income and benefits to eligible recipients.
- 9.2.12.CAP.13: Analyze how the economic, social, and political conditions of a time period can affect the labor market.
- 9.2.12.CAP.14: Analyze and critique various sources of income and available resources (e.g., financial assets, property, and transfer payments) and how they may substitute for earned income
- 9.2.12.CAP.15: Demonstrate how exemptions, deductions, and deferred income (e.g., retirement or medical) can reduce taxable income.
- 9.2.12.CAP.16: Explain why taxes are withheld from income and the relationship of federal, state, and local taxes (e.g., property, income, excise, and sales) and how the money collected is used by local, county, state, and federal governments. •
- 9.2.12.CAP.17: Analyze the impact of the collective bargaining process on benefits, income, and fair labor practice. •
- 9.2.12.CAP.18: Differentiate between taxable and nontaxable income from various forms of employment (e.g., cash business, tips, tax filing and withholding). •
- 9.2.12.CAP.19: Explain the purpose of payroll deductions and why fees for various benefits (e.g., medical benefits) are taken out of pay, including the cost of employee benefits to employers and self-employment income.
- 9.2.12.CAP.20: Analyze a Federal and State Income Tax Return



- 9.2.12.CAP.21: Explain low-cost and low-risk ways to start a business.
- 9.2.12.CAP.22: Compare risk and reward potential and use the comparison to decide whether starting a business is feasible.
- 9.2.12.CAP.23: Identify different ways to obtain capital for starting a business

### Essential Question(s)

- How does one prepare for a career?
- How does one improve marketability?
- Why is career planning important?
- What are the risks in starting a business?

### Content

- There are strategies to improve one's professional value and marketability.
- Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
- An individual's income and benefit needs and financial plan can change over time.
- Securing an income involve an understanding of the costs and time in preparing for a career field, interview and negotiation skills, job searches, resume development, prior experience, and vesting and retirement plans
- Understanding income involves an analysis of payroll taxes, deductions and earned benefits.
- There are ways to assess a business's feasibility and risk and to align it with an individual's financial goals

### Skills

- Act as a responsible and contributing community member and employee.
- Attend to financial well-being.
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Model integrity, ethical leadership and effective management.
- Plan education and career paths aligned to personal goals.



- Use technology to enhance productivity, increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

### Assessments

- Career Research Project
- Resume/Cover Letter

Course: Safety for Electricians

Length: Semester

### Standards

- 9.3.12.AC.1 Use vocabulary, symbols and formulas common to architecture and construction.
- 9.3.12.AC.2 Use architecture and construction skills to create and manage a project.
- 9.3.12.AC.3 Comply with regulations and applicable codes to establish and manage a legal and safe workplace.
- 9.3.12.AC.4 Evaluate the nature and scope of the Architecture & Construction Career Cluster and the role of architecture and construction in society and the economy.
- 9.3.12.AC.5 Describe the roles, responsibilities, and relationships found in the architecture and construction trades and professions, including labor/management relationships.
- 9.3.12.AC.6 Read, interpret and use technical drawings, documents and specifications to plan a project.
- 9.3.12.AC.7 Describe career opportunities and means to achieve those opportunities in each of the Architecture & Construction Career Pathways.

### Essential Question(s)





- How do you ensure and promote safety in electrical work, including identifying hazards and using safety equipment?
- What are the fundamental operating principles of common electrical tools and systems?
- How do mathematical skills, including calculations for units of measurement and combined operations, apply to electrical work?
- In what ways can you practically apply safety protocols and trade math skills in simulated electrical scenarios?
- What key insights and collaborative learning experiences have contributed to your understanding of electrical safety and trade math in this course?

## Content

- Introduction to Electrical Safety:
  - Understanding the importance of safety in the electrical field.
  - Identifying and following safe work practices and procedures.
  - Proper inspection and use of safety equipment.
- Basic Operating Principles:
  - Learning the fundamental operating principles of electrical tools and systems.
  - Hands-on experience with common electrical tools.
- Trade Math for Electricians:
  - Reinforcing and extending math skills learned in academic math classes.
  - Performing calculations for units of measurement in both inch-pound and metric systems.
  - Practical applications of combined operations with whole numbers.
- Practical Application:
  - Applying safety principles and practices in simulated electrical work scenarios.
  - Integrating trade math skills in solving real-world electrical problems.
- Interactive Learning:
  - Engaging in interactive lessons and discussions on electrical safety.
  - Collaborative problem-solving sessions to enhance understanding.
- Assessment and Evaluation:



- Regular assessments to measure understanding of safety protocols and mathematical concepts.
- Practical evaluations of safety procedures and tool usage

## Skills

- Safety Protocols:
  - Demonstrate the ability to identify and adhere to safety protocols in the electrical field.
  - Use safety equipment effectively and responsibly.
- Electrical Tools and Systems:
  - Apply fundamental operating principles of electrical tools and systems.
  - Operate common electrical tools safely and efficiently.
- Mathematical Skills:
  - Perform calculations for units of measurement in both inch-pound and metric systems.
  - Apply combined operations with whole numbers to solve electrical-related mathematical problems.
- Practical Application:
  - Apply safety principles in practical, simulated electrical work scenarios.
  - Use trade math skills to solve real-world electrical problems.
- Interactive Learning:
  - Engage in interactive lessons and discussions on electrical safety.
  - Collaborate with peers in problem-solving sessions to reinforce learning.
- Assessment and Evaluation:
  - Successfully complete assessments measuring understanding of safety protocols and mathematical concepts.
  - Demonstrate proficiency in practical evaluations of safety procedures and tool usage.

## Assessments

- Practical Safety Scenario
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- Design a practical safety scenario where students are presented with a simulated electrical work environment. Students must identify potential hazards, demonstrate the correct use of safety equipment, and outline a step-by-step procedure to ensure a safe working environment. This assessment evaluates their ability to apply safety principles in realistic scenarios.
- Math Application in Electrical Tasks
  - Develop a set of electrical tasks that require mathematical calculations, such as measuring voltage, current, or resistance. Students are tasked with performing the calculations accurately, demonstrating their understanding of trade math skills in the context of electrical work. This assessment assesses their ability to apply mathematical concepts to real-world electrical scenarios.

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Course: Introduction to Electrical Circuits

Length: Semester

Standards

- 9.3.12.AC-DES.3 Describe the requirements of the integral systems that impact the design of buildings.
- 9.3.12.AC-DES.4 Apply building codes, laws and rules in the project design.
- 9.3.12.AC-DES.5 Identify the diversity of needs, values and social patterns in project design, including accessibility standards.
- 9.3.12.AC-DES.6 Apply the techniques and skills of modern drafting, design, engineering and construction to projects.
- 9.3.12.AC-DES.7 Employ appropriate representational media to communicate concepts and project design.

Essential Question(s)



- What skills are crucial for working safely with electrical hand tools in the industry?
- How does understanding the various job titles in the electrical field contribute to career exploration?
- What key concepts underlie the operation of different types of DC sources in electrical circuits?
- Why is it important to grasp the concepts of conventional and electron flow, as well as voltage polarity, in DC circuits?
- How do Kirchhoff's Laws enhance the analysis of DC circuits, and how can they be practically applied?

## Content

- Hand Tools Identification and Usage:
  - Introduction to common hand tools used in the electrical industry.
  - Proper techniques for using and caring for hand tools.
- Careers in the Electrical Field:
  - Exploration of various job titles and roles within the electrical industry.
  - Consideration of aspects related to business ownership in the field.
- DC Theory Part I:
  - Introduction to different types of DC sources.
  - Explanation of DC circuit terminology and relevant concepts.
  - Demonstration of basic DC circuit calculations through examples.
- Conventional and Electron Flow:
  - Differentiation between conventional and electron flow in electrical circuits.
  - Understanding voltage polarity in DC circuits.
- Kirchhoff's Laws:
  - Definition and application of Kirchhoff's Laws in electrical circuits.
- DC Circuit Analysis:
  - Introduction to DC circuit analysis techniques.
- Faults in DC Circuits:
  - Recognition and understanding of common faults in DC circuits.

## Skills



- Hand Tools Proficiency:
  - Identify and correctly use common hand tools in the electrical industry.
  - Demonstrate proper techniques for handling and maintaining hand tools.
- Career Awareness:
  - Explore various job titles and roles within the electrical field.
  - Understand key aspects related to business ownership in the electrical industry.
- DC Theory Competence:
  - Differentiate between various types of DC sources.
  - Apply DC circuit terminology and concepts in problem-solving.
  - Perform basic DC circuit calculations using relevant examples.
- Understanding Flow and Polarity:
  - Explain the concepts of conventional and electron flow in electrical circuits.
  - Understand voltage polarity in DC circuits.
- Application of Kirchhoff's Laws:
  - Apply Kirchhoff's Laws to analyze DC circuits.
- DC Circuit Analysis Skills:
  - Utilize techniques for analyzing DC circuits.
- Recognition of Faults:
  - Identify and understand common faults in DC circuits.

## Assessments

- Hand Tools Proficiency Test:
    - Students will undergo a hands-on assessment where they demonstrate their proficiency in identifying, handling, and using common electrical hand tools safely. This practical test will evaluate their ability to choose the right tool for specific tasks and follow proper safety practices.
  - DC Circuit Analysis Project:
    - Students will be assigned a project that involves analyzing and designing a DC circuit. This assessment will test their understanding of DC circuit terminology, their ability to apply Kirchhoff's Laws, and their skill in calculating basic circuit parameters. Additionally, students will need to identify and
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troubleshoot potential faults within the circuit, showcasing their practical knowledge of DC circuit analysis.

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Course: Electrical Theory

Length: Semester

Standards

- 9.3.12.AC-CST.7 Compare and contrast the building systems and components required for a construction project.
- 9.3.12.AC-CST.8 Demonstrate the construction crafts required for each phase of a construction project.
- 9.3.12.AC-CST.9 Safely use and maintain appropriate tools, machinery, equipment and resources to accomplish construction project goals.

Essential Question(s)

- How does Ohm's Law apply to series, parallel, and series-parallel DC circuits, and how can it be used to calculate electrical values?
- What safety measures are essential for hazard-free electrical installations, and how can they be implemented in the electrical field?
- What are the key differences between direct current (DC) and alternating current (AC), and how do they impact electrical circuits?
- How do Kirchhoff's voltage and current laws contribute to the analysis of electrical circuits, especially in complex configurations?
- In what ways can the National Electric Code (NEC®) be utilized to navigate and ensure compliance with installation requirements for various electrical devices and wiring methods?



## Content

- Understanding DC Circuits:
  - Gain knowledge of common electrical theory in DC circuits.
  - Apply Ohm's law to series, parallel, and series-parallel circuits.
- Electrical Safety Protocols:
  - Emphasize the importance of safety in the electrical field.
  - Learn hazard-free installation practices and safety requirements.
- Introduction to Alternating Current (AC):
  - Understand fundamental concepts of alternating current.
  - Differentiate between DC and AC circuits.
- Application of Kirchhoff's Laws:
  - Learn and apply Kirchhoff's voltage and current laws.
  - Develop skills for analyzing and solving electrical circuits.
- National Electric Code (NEC®):
  - Understand the purpose and application of the NEC®.
  - Navigate the NEC® to find installation requirements for various electrical devices and wiring methods.

## Skills

- Apply Ohm's Law:
  - Calculate electrical values in series, parallel, and series-parallel DC circuits using Ohm's law.
- Implement Safety Measures:
  - Demonstrate hazard-free installation practices in the electrical field.
  - Identify and follow safety protocols and procedures.
- Understand Alternating Current:
  - Differentiate between direct current (DC) and alternating current (AC).
  - Explain fundamental concepts related to AC circuits.
- Apply Kirchhoff's Laws:
  - Analyze electrical circuits using Kirchhoff's voltage and current laws.



- Solve problems related to complex circuit configurations.
- Navigate NEC® Guidelines:
  - Utilize the National Electric Code (NEC®) to find installation requirements.
  - Apply NEC® guidelines to ensure compliance with electrical standards.

## Assessments

- Circuit Analysis Exam:
  - Evaluate students' understanding of DC circuit theory, including calculations for series, parallel, and series-parallel circuits.
  - Test application of Ohm's Law in different circuit configurations.
  - Assess comprehension of Kirchhoff's voltage and current laws in analyzing electrical circuits.
- NEC® Compliance Project:
  - Assign a project where students must design a residential electrical installation adhering to the National Electric Code (NEC®).
  - Evaluate students' ability to navigate the NEC® to find and apply installation requirements for various electrical devices and wiring methods.
  - Assess attention to safety and hazard-free practices in the proposed electrical design.

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Course: Residential Wiring I

Length: Semester

## Standards

- 9.3.12.AC-DES.1 Justify design solutions through the use of research documentation and analysis of data.
- 9.3.12.AC-DES.2 Use effective communication skills and strategies (listening, speaking, reading, writing and graphic communications) to work with clients and colleagues.
- 9.3.12.AC-DES.3 Describe the requirements of the integral systems that impact the design of buildings.





- 9.3.12.AC-DES.4 Apply building codes, laws and rules in the project design.
- 9.3.12.AC-DES.5 Identify the diversity of needs, values and social patterns in project design, including accessibility standards.

### Essential Question(s)

- How do you apply Ohm's law to analyze and calculate electrical circuits in residential wiring?
- What is the significance of Kirchhoff's voltage and current laws in the context of residential electric installations?
- How do you effectively use the National Electric Code (NEC) to ensure compliance with safety and installation standards in residential wiring?
- What are the roles of the National Electrical Manufacturers Association (NEMA) and Nationally Recognized Testing Laboratories (NRTL) in the electrical industry?
- Can you demonstrate a thorough understanding of device boxes, their types, and the NEC® fill requirements for different electrical applications in residential settings?

### Content

- DC Theory II:
  - Basic concepts of direct and alternating current.
  - Application of Ohm's law to series, parallel, and series-parallel circuits.
- Residential Electric Part I:
  - Kirchhoff's voltage and current laws.
  - Purpose and application of the NEC®.
- National Electric Code (NEC) Part I:
  - Understanding and using the NEC® for installation requirements.
  - Overview of the National Electrical Manufacturers Association (NEMA) and Nationally Recognized Testing Laboratories (NRTL).
- Device Boxes and Fill Requirements:
  - Types of device boxes and their applications.



- Calculating NEC® fill requirements for outlet and junction boxes.
- Switches and Receptacles:
  - Various types and uses of switches and receptacles.
  - Proper installation and allowable ratings.
- Blueprint Reading and Scale Drawings:
  - Fundamental concepts of blueprint reading.
  - Understanding scale drawings in the context of electrical installations.

## Skills

- DC Theory II:
  - Apply the basic concepts of direct and alternating current.
  - Demonstrate the application of Ohm's law to series, parallel, and series-parallel circuits.
- Residential Electric Part I:
  - Apply Kirchhoff's voltage and current laws to electrical circuits.
  - Understand and apply the purpose of the NEC® in residential electrical work.
- National Electric Code (NEC) Part I:
  - Utilize the NEC® to determine installation requirements for various electrical devices and wiring methods.
  - Recognize and explain the roles of the National Electrical Manufacturers Association (NEMA) and Nationally Recognized Testing Laboratories (NRTL).
- Device Boxes and Fill Requirements:
  - Identify and select appropriate device boxes for specific applications.
  - Calculate NEC® fill requirements for outlet and junction boxes.
- Switches and Receptacles:
  - Differentiate between various types of switches and receptacles.
  - Safely install switches and receptacles according to NEC® guidelines.
- Blueprint Reading and Scale Drawings:
  - Interpret and understand blueprint drawings related to electrical installations.
  - Apply knowledge of scale drawings to plan and execute electrical work accurately.



## Assessments

- NEC Compliance Exam:
  - Students are presented with various residential wiring scenarios. They must identify and apply the relevant NEC regulations for each scenario, ensuring compliance and safety. The assessment includes questions related to device boxes, wiring methods, and allowable ratings.
- Practical Wiring Project:
  - Students are given a residential wiring project blueprint. They are required to plan and execute the wiring installation according to NEC guidelines. The assessment evaluates their ability to select appropriate devices, calculate box fill requirements, and implement proper wiring techniques.

Course: Residential Wiring II

Length: Semester

## Standards

- 9.3.12.AC-DES.1 Justify design solutions through the use of research documentation and analysis of data.
- 9.3.12.AC-DES.2 Use effective communication skills and strategies (listening, speaking, reading, writing and graphic communications) to work with clients and colleagues.
- 9.3.12.AC-DES.3 Describe the requirements of the integral systems that impact the design of buildings.
- 9.3.12.AC-DES.4 Apply building codes, laws and rules in the project design.
- 9.3.12.AC-DES.5 Identify the diversity of needs, values and social patterns in project design, including accessibility standards.

## Essential Question(s)

- How do you analyze and plan the electrical installations for each room in a residential dwelling, considering industry standards and code requirements?



- What are the key characteristics and applications of various cables and devices commonly used in residential electrical installations?
- How do you ensure proper installation of conductors using fish tape and power conduit fishing systems in different electrical scenarios?
- What are the NEC® requirements and installation practices associated with various raceway systems in residential wiring?
- How do you select and install Overcurrent Protection Devices (OCPDs) based on the rating systems, and what considerations are essential for appliances and special circuits in residential settings?

## Content

- Residential Room Layouts:
  - Understanding the layout of residential dwellings room by room in accordance with industry standards and codes.
  - Identifying code and industry requirements for electrical installations in different residential spaces.
- Electrical Components and Devices:
  - Knowledge of various cables and devices used in electrical installations.
  - Understanding conductor types, cable markings, color codes, and ampacity derating.
- Conductor Installation Techniques:
  - Using fish tape and power conduit fishing systems for conductor installation.
  - Knowledge of various raceway systems and their installation, including NEC® requirements.
- Conduit Bodies and Appliance Installation:
  - Understanding the use of conduit bodies in electrical installations.
  - Installation practices for various appliances and special circuits.
- OCPD Rating Systems:
  - Knowledge of rating systems for Overcurrent Protection Devices (OCPD).
  - Understanding how to select and install OCPDs in residential wiring.
- Continuation of DC Theory:
  - Application of DC Theory in the transition to AC Theory.
  - Calculations of electrical circuits using the principles learned in DC Theory.



## Skills

- Residential Room Layouts:
  - Analyze and interpret residential dwelling layouts room by room according to industry standards and codes.
  - Apply code and industry requirements to plan electrical installations in various residential spaces.
- Electrical Components and Devices:
  - Identify and differentiate various cables and devices commonly used in electrical installations.
  - Demonstrate knowledge of conductor types, cable markings, color codes, and ampacity derating principles.
- Conductor Installation Techniques:
  - Effectively use fish tape and power conduit fishing systems for the installation of conductors.
  - Demonstrate proficiency in installing various raceway systems while adhering to NEC® requirements.
- Conduit Bodies and Appliance Installation:
  - Understand the purpose and application of conduit bodies in electrical installations.
  - Demonstrate proper installation practices for various appliances and special circuits.
- OCPD Rating Systems:
  - Understand the rating systems for selecting Overcurrent Protection Devices (OCPD).
  - Apply knowledge to select and install appropriate OCPDs in residential wiring scenarios.
- Continuation of DC Theory:
  - Apply DC Theory principles in the transition to AC Theory.
  - Perform calculations for electrical circuits using the foundational concepts learned in DC Theory.

## Assessments

- Residential Wiring Project:
    - Students will be tasked with planning and executing a comprehensive residential wiring project. They must demonstrate their ability to apply code requirements, industry standards, and proper installation techniques for various electrical components in different rooms. The assessment will include a detailed project report and an oral presentation explaining their choices and methods.
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- Code Compliance Exam:
  - Students will take an exam assessing their understanding of the National Electric Code (NEC) and industry standards related to residential wiring. The exam will include scenarios and questions covering conductor types, cable markings, color codes, ampacity derating, raceway systems, conduit bodies, and OCPD selection. This assessment aims to evaluate their knowledge of code compliance and application in residential electrical installations.

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Course: Commercial Wiring I

Length: Semester

### Standards

- 9.3.12.AC-MO.1 Recognize and employ universal construction signs and symbols to function safely in the workplace.
- 9.3.12.AC-MO.2 Use troubleshooting procedures when solving a maintenance problem in buildings.
- 9.3.12.AC-MO.3 Apply construction skills when repairing, restoring or renovating existing buildings.
- 9.3.12.AC-MO.4 Determine work required to repair or renovate an existing building.
- 9.3.12.AC-MO.5 Plan and practice preventative maintenance activities to service existing buildings.
- 9.3.12.AC-MO.6 Maintain and inspect building systems to achieve safe and efficient operation of buildings.

### Essential Question(s)

- What role do electrical symbols play in conveying information on construction drawings in commercial wiring?
- How are factors like ampacity and conductor insulation crucial considerations in the selection of conductors for commercial dwellings, following code and industry standards?



- What considerations and calculations go into determining the required number of branch circuits for specific loads in commercial settings?
- How is the correct rating for branch-circuit protective devices calculated and determined in the context of commercial wiring?
- What are the key requirements outlined in Chapter 3 of the National Electric Code (NEC) regarding wiring methods and materials for commercial installations?

## Content

- Interpreting Electrical Symbols:
  - Understanding and interpreting electrical symbols commonly used in construction drawings.
- Conductor Selection for Commercial Dwellings:
  - Factors influencing conductor selection, including ampacity and insulation, adhering to code and industry standards.
- Branch Circuit Determination:
  - Techniques for determining the required number of branch circuits for specific loads in commercial settings.
- Branch-Circuit Protective Device Rating:
  - Understanding how to determine the correct rating for branch-circuit protective devices.
- General Requirements for Wiring Methods and Materials:
  - Familiarity with Chapter 3 of the National Electric Code (NEC), covering general requirements for wiring methods and materials.
- Math Skills Application:
  - Applying math skills learned in academic classes to perform calculations involving percent, average, and combined operations.

## Skills

- Interpretation of Electrical Symbols in Construction Drawings:



- Demonstrate proficiency in interpreting and understanding electrical symbols commonly used in construction drawings.
- Conductor Selection in Commercial Dwellings:
  - Apply knowledge of factors influencing conductor selection, considering ampacity and insulation, in compliance with code and industry standards.
- Branch Circuit Planning:
  - Determine the required number of branch circuits for specific loads in commercial settings.
- Branch-Circuit Protective Devices:
  - Calculate and determine the correct rating for branch-circuit protective devices.
- Wiring Methods and Materials (Chapter 3 NEC):
  - Implement general requirements for wiring methods and materials outlined in Chapter 3 of the National Electric Code (NEC) for various wiring installations.
- Mathematical Applications in Commercial Wiring:
  - Apply math skills, including calculations involving percent, average, and combined operations, to address mathematical aspects of commercial wiring.

## Assessments

- Construction Drawing Analysis:
    - Task: Students analyze a set of commercial construction drawings and identify and interpret electrical symbols used in the plans.
      - Assessment Criteria: Accuracy in identifying symbols, understanding their meanings, and relating them to the electrical components in the drawings.
  - Load Calculation and Circuit Design:
    - Task: Students are presented with a scenario of a commercial space with various electrical loads. They calculate the required number of branch circuits, determine appropriate conductor types, and select the correct branch-circuit protective devices.
      - Assessment Criteria: Accuracy in load calculations, appropriate selection of conductors and protective devices, and adherence to NEC requirements.
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Course: Commercial Wiring II

Length: Semester

### Standards

- 9.3.12.AC-MO.1 Recognize and employ universal construction signs and symbols to function safely in the workplace.
- 9.3.12.AC-MO.2 Use troubleshooting procedures when solving a maintenance problem in buildings.
- 9.3.12.AC-MO.3 Apply construction skills when repairing, restoring or renovating existing buildings.
- 9.3.12.AC-MO.4 Determine work required to repair or renovate an existing building.
- 9.3.12.AC-MO.5 Plan and practice preventative maintenance activities to service existing buildings.
- 9.3.12.AC-MO.6 Maintain and inspect building systems to achieve safe and efficient operation of buildings.

### Essential Question(s)

- How do you ensure the safe and code-compliant connection of appliances in commercial wiring, considering industry standards?
- What AC theory concepts are essential for applications and code calculations in commercial electrical installations?
- Can you demonstrate the correct installation procedures for electric ranges, electric heating systems, and other electrical devices in a commercial setting, following industry codes?
- How would you approach troubleshooting and identifying faults in electrical equipment commonly used in commercial dwellings?
- In what ways do meters play a crucial role in AC theory and code calculations for commercial wiring, and how do you apply them effectively in practice?

### Content



- Appliance Connections and Code Requirements
  - Understanding fundamental concepts and code requirements for connecting appliances in commercial settings, ensuring safety and compliance with industry standards.
- AC Theory Concepts for Applications and Code Calculations
  - Grasping AC theory concepts essential for practical applications and performing code calculations related to commercial wiring.
- Installation of Electric Ranges and Heating Devices
  - Learning the proper installation procedures for electric ranges, electric heating systems, and other electrical devices required or recommended in commercial dwellings according to code and industry standards.
- Troubleshooting Skills for Electrical Equipment
  - Developing skills to troubleshoot and diagnose faults or malfunctions in electrical equipment commonly used in commercial settings.
- Meter Applications in AC Theory and Code Calculations
  - Understanding the use of meters in the context of AC theory and applying them to perform code-related calculations in commercial wiring scenarios.
- Math Skills Reinforcement
  - Reinforcing and extending mathematical skills, including calculations involving combined operations with interest and ratio, relevant to commercial wiring applications.

## Skills

- Apply Appliance Connections and Code Requirements:
  - Demonstrate the ability to connect appliances in commercial settings while adhering to safety standards and industry codes.
- Apply AC Theory Concepts for Applications and Code Calculations:
  - Utilize AC theory concepts for practical applications and perform code calculations relevant to commercial wiring scenarios.
- Execute Installation of Electric Ranges and Heating Devices:



- Perform proper installation procedures for electric ranges, electric heating systems, and other electrical devices in accordance with code and industry standards.
- Demonstrate Troubleshooting Skills for Electrical Equipment:
  - Exhibit proficiency in troubleshooting and diagnosing faults or malfunctions in commonly used electrical equipment in commercial settings.
- Apply Meter Applications in AC Theory and Code Calculations:
  - Effectively use meters in the context of AC theory and apply them to perform code-related calculations in commercial wiring applications.
- Reinforce Math Skills:
  - Reinforce and extend mathematical skills, including calculations involving combined operations with interest and ratio, relevant to commercial wiring.

## Assessments

- Commercial Wiring II Practical Assessment: Appliance Installation and Troubleshooting
  - Task: Students will be provided with a set of commercial appliances, including electric ranges and heating systems. They are required to install and wire these appliances in accordance with industry standards and electrical codes.
    - Assessment Criteria
      - Accuracy of Wiring: Ensure that students correctly connect the appliances, considering safety and adherence to codes.
      - Troubleshooting Skills: Evaluate the ability to identify and rectify any issues that may arise during installation.
      - Compliance with Standards: Assess whether the installations meet industry standards and comply with relevant codes.
  - Code Calculations and Meter Applications Exam:
  - Task: Students will be presented with commercial wiring scenarios requiring code calculations and meter applications. They must perform calculations and use meters to analyze and assess the electrical parameters.
    - Assessment Criteria:
      - Accuracy of Calculations: Evaluate the correctness of code calculations performed by students.
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- Meter Applications: Assess the proficiency in using meters to measure and analyze electrical characteristics.
- Adherence to Code: Ensure that students apply the appropriate electrical codes and standards in their calculations and assessments.

Course: AC Theory

Length: Semester

### Standards

- 9.3.12.AC-DES.4 Apply building codes, laws and rules in the project design. 9.3.12.AC-DES.5 Identify the diversity of needs, values and social patterns in project design, including accessibility standards. 9.3.12.AC-DES.6 Apply the techniques and skills of modern drafting, design, engineering and construction to projects. 9.3.12.AC-DES.7 Employ appropriate representational media to communicate concepts and project design.
- 9.3.12.AC-DES.4 Apply building codes, laws and rules in the project design. 9.3.12.AC-DES.5 Identify the diversity of needs, values and social patterns in project design, including accessibility standards. 9.3.12.AC-DES.6 Apply the techniques and skills of modern drafting, design, engineering and construction to projects. 9.3.12.AC-DES.7 Employ appropriate representational media to communicate concepts and project design.

### Essential Question(s)

- How does the proper use of tools contribute to the safety and efficiency of commercial electrical work?
- What are the key considerations and code requirements when installing special cables and equipment in commercial electrical installations?
- How do alternating current (AC) electrical circuits differ from direct current (DC) circuits, and what are the fundamental principles governing AC circuits?



- Why is a clear understanding of associated terminology crucial for effective communication in the field of commercial electrical work?
- How can mathematical skills, particularly in powers and roots, be applied to solve practical problems encountered in AC electrical calculations for commercial installations?

## Content

- Proper Tool Use and Equipment Installation:
  - Introduction to and practical training in using tools and equipment relevant to commercial electrical work.
  - Installation procedures for special cables and equipment, meeting industry standards and local code requirements.
- Basic Concepts of Alternating Current (AC) Electrical Circuits:
  - Understanding the fundamentals of AC electrical circuits, including principles of voltage, current, and resistance in AC systems.
  - Exploration of AC circuit components and their behavior, emphasizing practical applications in commercial settings.
- Associated Terminology:
  - Familiarization with key terminology related to AC electrical circuits, ensuring students can effectively communicate and understand concepts within the industry.
- Code Requirements and Local Jurisdiction:
  - In-depth exploration of commercial and code requirements governing AC electrical systems.
  - Understanding local jurisdictional regulations and compliance standards for AC installations in commercial settings.
- Mathematical Applications:
  - Application of mathematical skills to AC electrical calculations, including powers and roots.
  - Practical exercises reinforcing the use of math in solving real-world problems encountered in commercial AC electrical work.

## Skills



- Demonstrate Proficient Tool Use:
  - Use tools and equipment commonly employed in commercial electrical work with precision and adherence to safety practices.
- Execute Proper Installation of Special Cables and Equipment:
  - Implement correct procedures for installing special cables and equipment, ensuring compliance with industry standards and local code requirements.
- Apply Understanding of AC Electrical Circuits:
  - Apply a comprehensive understanding of AC electrical circuits, including the principles of voltage, current, resistance, and the behavior of components.
- Utilize Associated Terminology Effectively:
  - Effectively use and understand the terminology associated with AC electrical circuits, facilitating clear communication within the industry.
- Ensure Compliance with Code Requirements and Local Jurisdiction:
  - Interpret and apply commercial and code requirements governing AC electrical systems, ensuring installations align with local jurisdictional regulations.
- Apply Mathematical Skills to AC Electrical Calculations:
  - Apply mathematical skills to perform AC electrical calculations, including powers and roots, for practical problem-solving in commercial electrical work.

## Assessments

- Wiring Installation Project
    - In this assessment, students will undertake a hands-on wiring installation project in a simulated commercial setting. They will be provided with a detailed electrical plan and tasked with executing the wiring according to industry standards and local codes. The assessment will evaluate their ability to select and install appropriate cables, equipment, and adhere to safety protocols. Additionally, students will be assessed on their troubleshooting skills to identify and rectify potential faults.
  - AC Electrical Calculations Exam
    - The AC Electrical Calculations Exam will assess students' theoretical knowledge and practical application of AC electrical concepts. Students will be presented with various scenarios requiring
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calculations related to power factors, voltage drops, and circuit characteristics. The assessment aims to evaluate their proficiency in performing accurate calculations, applying relevant formulas, and demonstrating a comprehensive understanding of AC electrical terminology.

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Course: Industrial Motor Control I

Length: Semester

### Standards

- 9.3.12.AC-DES.4 Apply building codes, laws and rules in the project design.
- 9.3.12.AC-DES.5 Identify the diversity of needs, values and social patterns in project design, including accessibility standards.
- 9.3.12.AC-DES.6 Apply the techniques and skills of modern drafting, design, engineering and construction to projects.
- 9.3.12.AC-DES.7 Employ appropriate representational media to communicate concepts and project design.

### Essential Question(s)

- What are the fundamental components of a basic control circuit, and how are they applied in industrial motor controls?
- How do you troubleshoot common issues in basic control circuits, and what problem-solving techniques are effective in resolving circuit problems?
- What is the significance of AC and DC drive systems in industrial settings, and how are they incorporated into motor control circuits?
- What are the key considerations when differentiating between manual and automatic motor control, and how do these modes impact industrial operations?



- How do symbols in schematic diagrams and the logic of ladder diagrams contribute to understanding and designing effective motor control systems in an industrial context?

## Content

- Basic Control Circuits and Components:
  - Study of electric motors and control systems
  - Basic control circuits and components
- Installation, Wiring, and Wiring Diagrams:
  - Installation procedures for electric motors and control systems
  - Wiring techniques and practices
  - Interpretation of wiring diagrams
- Troubleshooting of Basic Control Circuits:
  - Identifying and resolving issues in basic control circuits
  - Troubleshooting techniques for motor control systems
- Study of AC and DC Drives:
  - Understanding the operation of AC and DC drives
  - Application of AC and DC drives in industrial settings
- Operation of Common Control Devices:
  - Functions and usage of common control devices
  - Integration of control devices in motor control circuits
- Function and Usage of Control Components in Motor Control Circuits:
  - Understanding the purpose and application of control components
  - Usage of control components in motor control circuits
- Purpose and General Principles of Motor Control:
  - Exploring the purpose and principles behind motor control systems
- Differences Between Manual and Automatic Motor Control:
  - Distinctions between manual and automatic motor control systems
  - Considerations for selecting the appropriate control mode
- Considerations in Installing Motors or Control Equipment:





- Factors to consider when installing motors and control equipment in industrial settings
- Basic Functions of a Control System:
  - Overview of the fundamental functions of a control system
- Symbols Used in Schematic Diagrams:
  - Interpretation of symbols commonly used in schematic diagrams
- Interpretation of the Logic of a Simple Ladder Diagram:
  - Understanding the logic and structure of ladder diagrams in motor control
- Application of Length Measure Calculations:
  - Utilizing length measure calculations relevant to industrial motor controls.

## Skills

- Apply Basic Control Circuit Knowledge:
  - Demonstrate an understanding of electric motors and basic control circuits.
  - Apply knowledge of basic control components in practical scenarios.
- Execute Installation and Wiring Procedures:
  - Successfully install electric motors and control systems.
  - Effectively execute wiring practices and interpret wiring diagrams.
- Troubleshoot Basic Control Circuits:
  - Identify and resolve issues in basic control circuits through troubleshooting.
  - Demonstrate problem-solving skills in resolving common circuit problems.
- Understand AC and DC Drive Systems:
  - Explain the operation of AC and DC drives.
  - Apply knowledge of AC and DC drives in industrial contexts.
- Operate Common Control Devices:
  - Demonstrate the operation and usage of common control devices.
  - Integrate control devices into motor control circuits.
- Utilize Control Components in Motor Control:
  - Understand the purpose and principles of control components.
  - Apply control components effectively in motor control circuits.



- Grasp Motor Control Principles:
  - Explain the purpose and general principles of motor control systems.
- Differentiate Manual and Automatic Control:
  - Identify differences between manual and automatic motor control.
  - Evaluate considerations for selecting the appropriate control mode.
- Considerations in Equipment Installation:
  - Apply factors to consider when installing motors and control equipment.
  - Ensure adherence to safety and industry standards during installation.
- Understand Control System Functions:
  - Describe the basic functions of a control system.
- Interpret Symbols in Schematic Diagrams:
  - Recognize and interpret symbols commonly used in schematic diagrams.
- Analyze Ladder Diagram Logic:
  - Interpret the logic and structure of a simple ladder diagram in motor control.
- Apply Length Measure Calculations:
  - Utilize length measure calculations relevant to industrial motor controls.

## Assessments

- Control Circuit Troubleshooting Practical Exam:
    - Task: Students will be presented with malfunctioning control circuits and diagrams. Their task is to identify and troubleshoot the issues within a specified time frame.
      - Assessment Criteria: Evaluation will be based on the accuracy and efficiency of troubleshooting, understanding of circuit components, and the ability to apply problem-solving techniques.
  - Motor Control System Design Project:
    - Task: Students will design a motor control system for a specific industrial application. This includes creating schematic diagrams, selecting appropriate components, and justifying design choices.
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- Assessment Criteria: Assessment will focus on the completeness and accuracy of the design, understanding of industrial motor control principles, and the ability to translate theoretical knowledge into practical applications.

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Course: Industrial Motor Control II

Length: Semester

Standards

- 9.3.12.AC-MO.1 Recognize and employ universal construction signs and symbols to function safely in the workplace.
- 9.3.12.AC-MO.2 Use troubleshooting procedures when solving a maintenance problem in buildings.
- 9.3.12.AC-MO.3 Apply construction skills when repairing, restoring or renovating existing buildings.
- 9.3.12.AC-MO.4 Determine work required to repair or renovate an existing building.
- 9.3.12.AC-MO.5 Plan and practice preventative maintenance activities to service existing buildings.
- 9.3.12.AC-MO.6 Maintain and inspect building systems to achieve safe and efficient operation of buildings.

Essential Question(s)

- How do you systematically approach troubleshooting motor control systems, considering schematic diagrams and industry terminology?
- What are the fundamental differences between AC and DC drives, and how do you determine their optimal applications in industrial settings?
- How proficient are you in interpreting and creating accurate wiring diagrams for complex motor control systems?
- Explain the operational principles of start-stop, forward-reverse-stop push button controls in motor control circuits.



- How do you apply interlocking methods to ensure the safe and efficient operation of motor control circuits, incorporating relays, limit switches, and other components?

## Content

- Maintenance of Electric Motors:
  - Understanding maintenance practices for electric motors used in industrial settings.
  - Techniques for proper installation and wiring of industrial motors.
- Troubleshooting Motor Controls:
  - Identifying and resolving issues in motor control systems.
  - Utilizing schematic diagrams for effective troubleshooting.
- AC and DC Drives:
  - Studying the principles and applications of AC and DC drives in industrial contexts.
  - Understanding the differences between AC and DC drive systems.
- Terminology and Symbolism:
  - Learning industry-specific terminology, symbols, and definitions related to motor controls.
  - Developing the ability to interpret and create wiring diagrams.
- Push Button Control Operations:
  - Explaining the operation of start-stop, forward-reverse-stop push button controls.
  - Drawing wiring diagrams from schematic diagrams.
- Interlocking Methods:
  - Understanding interlocking methods in motor control circuits.
  - Connecting various components like relays, limit switches, and jogging circuits.
- Application Circuits:
  - Connecting start-stop push button control circuits.
  - Creating circuits for relay integration, forward-reverse motor control, jogging, and limit switches.
- Math Skills Reinforcement:
  - Applying ratio and proportion calculations in the context of industrial motor controls.

## Skills



- Maintenance of Electric Motors:
  - Demonstrate proficiency in executing routine maintenance tasks for electric motors in industrial settings.
  - Apply knowledge to ensure proper installation and wiring practices for enhanced motor longevity.
- Troubleshooting Motor Controls:
  - Develop the ability to identify and troubleshoot issues in motor control systems efficiently.
  - Utilize schematic diagrams as a tool for systematic problem-solving.
- AC and DC Drives:
  - Understand the principles governing the operation and applications of AC and DC drives.
  - Differentiate between AC and DC drive systems and comprehend their specific use cases.
- Terminology and Symbolism:
  - Acquire a comprehensive understanding of industry-specific terminology, symbols, and definitions.
  - Apply knowledge to interpret and create accurate wiring diagrams for motor control systems.
- Push Button Control Operations:
  - Demonstrate a clear understanding of the operation of start-stop, forward-reverse-stop push button controls.
  - Proficiently draw wiring diagrams based on given schematic diagrams.
- Interlocking Methods:
  - Apply knowledge of interlocking methods to design effective motor control circuits.
  - Connect various components such as relays, limit switches, and jogging circuits to achieve desired interlocking.
- Application Circuits:
  - Successfully connect start-stop push button control circuits in practical applications.
  - Create functional circuits integrating relays, forward-reverse motor control, jogging, and limit switches.
- Math Skills Reinforcement:
  - Apply ratio and proportion calculations effectively in the context of industrial motor controls.
  - Utilize mathematical skills to solve problems related to length measurement in motor control scenarios.



## Assessments

- Troubleshooting Scenario:
  - Assessment involves presenting students with a simulated industrial motor control system malfunction. Students must identify and rectify the issue by analyzing schematic diagrams, utilizing industry terminology, and demonstrating effective troubleshooting skills. Evaluation criteria include accuracy, speed, and systematic approach.
- Motor Control System Design Project:
  - Students are tasked with designing a comprehensive motor control system for a specific industrial application. This includes creating wiring diagrams, selecting appropriate components, and justifying design choices. Assessment criteria encompass the completeness of the design, adherence to industry standards, and the ability to articulate design decisions.

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Course: Industrial Motor Control III

Length: Semester

## Standards

- 9.3.12.AC-MO.1 Recognize and employ universal construction signs and symbols to function safely in the workplace.
- 9.3.12.AC-MO.2 Use troubleshooting procedures when solving a maintenance problem in buildings.
- 9.3.12.AC-MO.3 Apply construction skills when repairing, restoring or renovating existing buildings.
- 9.3.12.AC-MO.4 Determine work required to repair or renovate an existing building.
- 9.3.12.AC-MO.5 Plan and practice preventative maintenance activities to service existing buildings.
- 9.3.12.AC-MO.6 Maintain and inspect building systems to achieve safe and efficient operation of buildings.



## Essential Question(s)

- What are the fundamental terminology and symbols crucial for understanding electric motors and control systems in an industrial setting?
- How do you approach troubleshooting in motor control systems, and what methodologies are effective in identifying and resolving issues?
- What are the key principles and applications of AC and DC drives, and how are they integrated into industrial motor control scenarios?
- How does one develop a motor control circuit step by step, taking into account specific requirements and constraints?
- How can theoretical knowledge be practically applied in real-life industrial environments when dealing with motor controls?

## Content

- Terminology and Symbols:
  - Understanding industry-specific terms, symbols, and definitions related to electric motors and control systems.
- Wiring and Diagramming:
  - Mastery of wiring techniques and the ability to create and interpret wiring diagrams for motor controls.
- Troubleshooting Skills:
  - Proficiency in diagnosing and resolving issues in motor control systems, applying troubleshooting methodologies.
- AC and DC Drives:
  - In-depth knowledge of AC and DC drives, their applications, and integration into industrial settings.
- Application of Theory:
  - Practical application of theoretical knowledge to hands-on scenarios, allowing students to implement motor control in real-life settings.
- Motor Control Circuit Development:



- Step-by-step process for developing motor control circuits, considering specific requirements and constraints.
- Drawing Control Circuits:
  - Ability to draw accurate and comprehensive control circuits based on given specifications.
- Math Skills Extension:
  - Utilization and extension of math skills, including calculations involving formulas relevant to industrial motor controls.

## Skills

- Terminology and Symbols Mastery:
  - Define and explain key terminology, symbols, and definitions associated with electric motors and control systems in the industrial context.
- Wiring and Diagramming Proficiency:
  - Demonstrate the ability to execute precise wiring techniques for motor controls.
  - Create, interpret, and analyze wiring diagrams related to motor control systems.
- Troubleshooting Skills Development:
  - Apply effective troubleshooting methodologies to identify and resolve issues in motor control systems.
  - Utilize diagnostic skills to assess and rectify common problems encountered in industrial motor controls.
- AC and DC Drives Understanding:
  - Explain the principles and applications of AC and DC drives in industrial settings.
  - Demonstrate knowledge of integrating AC and DC drives into practical motor control scenarios.
- Application of Theory in Real-Life Settings:
  - Apply theoretical knowledge to hands-on learning experiences in real-life industrial environments.
  - Execute motor control tasks following industry standards and best practices.
- Motor Control Circuit Development:
  - Outline the step-by-step process for developing motor control circuits, considering specific requirements and constraints.
- Drawing Accurate Control Circuits:





- Draw precise and comprehensive control circuits based on given specifications and requirements.
- Extension of Math Skills:
  - Extend mathematical skills to perform calculations and apply formulas relevant to industrial motor controls.

## Assessments

- Practical Motor Control Project:
  - Students will design and implement a comprehensive motor control circuit for a simulated industrial scenario. The project will require them to apply theoretical concepts, consider safety measures, and troubleshoot potential issues. Assessment criteria will include the accuracy of the circuit, adherence to industry standards, and the effectiveness of troubleshooting methods employed.
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- Troubleshooting Simulation Exam:
  - In a controlled simulation environment, students will encounter various motor control scenarios with intentional faults. They will be tasked with identifying and rectifying issues within a specified time frame. This assessment aims to evaluate their troubleshooting skills, understanding of terminology, and ability to apply theoretical knowledge in practical situations. Evaluation will be based on the accuracy and efficiency of problem-solving.

Course: Green Technologies in Electric

Length: Semester

## Standards

- 9.3.12.AC.4 Evaluate the nature and scope of the Architecture & Construction Career Cluster and the role of architecture and construction in society and the economy.
- 9.3.12.AC.5 Describe the roles, responsibilities, and relationships found in the architecture and



- construction trades and professions, including labor/management relationships.
- 9.3.12.AC.6 Read, interpret and use technical drawings, documents and specifications to plan a project.
- 9.3.12.AC.7 Describe career opportunities and means to achieve those opportunities in each of the
- Architecture & Construction Career Pathways.

### Essential Question(s)

- How can renewable energy sources be effectively harnessed to generate electricity in electrical systems?
- What are the key considerations in designing and implementing energy-efficient lighting systems using LED technologies?
- How can electrical systems be integrated into green building design to promote sustainability?
- What steps are involved in conducting an environmental impact assessment for electrical projects, and how can these be mitigated?
- How do advancements in green electrical technologies contribute to the overall goal of achieving a more sustainable and eco-friendly future?

### Content

- Renewable Energy Sources:
  - Explore various renewable energy sources, including solar, wind, and hydropower.
  - Understand the principles behind harnessing renewable energy for electricity generation.
- Energy-Efficient Technologies:
  - Study energy-efficient devices and technologies in the electrical domain.
  - Learn how to optimize energy consumption in electrical systems.
- Sustainable Electrical Practices:
  - Examine sustainable practices in electrical installations and systems.
  - Understand eco-friendly approaches to wiring, circuit design, and equipment selection.
- Solar Power Systems:
  - Explore the design and implementation of solar power systems.



- Learn about photovoltaic cells, solar panels, and the integration of solar energy into electrical grids.
- Energy-Efficient Lighting:
  - Study advanced lighting technologies for energy efficiency.
  - Explore LED lighting systems and their applications in residential and commercial settings.
- Green Building Technologies:
  - Understand the role of electrical systems in green building design.
  - Explore smart technologies for energy management in sustainable construction.
- Hands-on Projects:
  - Engage in practical projects to apply theoretical knowledge.
  - Design and implement green energy solutions in real-world scenarios.
- Environmental Impact Assessment:
  - Evaluate the environmental impact of electrical systems and technologies.
  - Analyze the life cycle of electrical components and their sustainability.
- Regulations and Standards:
  - Familiarize yourself with environmental regulations and standards in the electrical industry.
  - Learn how to comply with eco-friendly practices and certifications.
- Innovations in Green Technologies:
  - Stay updated on the latest innovations in green electrical technologies.
  - Explore emerging trends that contribute to a more sustainable electrical future.

## Skills

- Demonstrate Knowledge of Renewable Energy:
  - Identify and explain various renewable energy sources.
  - Understand the fundamental principles behind converting renewable energy into electricity.
- Implement Energy-Efficient Technologies:
  - Apply knowledge of energy-efficient devices and technologies in electrical systems.
  - Optimize energy consumption through practical applications.
- Integrate Sustainable Practices:
  - Incorporate sustainable practices in electrical installations and systems.



- Apply eco-friendly approaches to wiring, circuit design, and equipment selection.
- Design and Implement Solar Power Systems:
  - Design solar power systems considering photovoltaic cells and solar panel technologies.
  - Implement solar energy solutions in both standalone and grid-connected configurations.
- Optimize Lighting for Energy Efficiency:
  - Evaluate and choose energy-efficient lighting technologies.
  - Design and implement LED lighting systems for residential and commercial purposes.
- Apply Green Building Technologies:
  - Integrate electrical systems into green building design.
  - Utilize smart technologies for effective energy management in sustainable construction.
- Execute Hands-on Green Energy Projects:
  - Execute practical projects to implement green energy solutions.
  - Demonstrate proficiency in designing and implementing sustainable electrical solutions.
- Conduct Environmental Impact Assessments:
  - Evaluate the environmental impact of electrical systems.
  - Analyze the life cycle of electrical components to assess their sustainability.
- Comply with Environmental Regulations:
  - Understand and adhere to environmental regulations and standards in the electrical industry.
  - Ensure compliance with eco-friendly practices and certifications.
- Stay Informed on Innovations:
  - Stay informed about the latest innovations in green electrical technologies.
  - Explore and assess emerging trends contributing to a more sustainable electrical future.

## Assessments

- Green Technologies Project:
    - Task: Students will design and implement a green technology project, incorporating renewable energy sources, energy-efficient lighting, and sustainable electrical systems. They must provide a detailed project plan, including system diagrams, energy calculations, and environmental impact assessments.
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- Assessment Criteria: Evaluation will be based on the thoroughness of the project plan, integration of green technologies, consideration of environmental impact, and the feasibility of implementation.
  - Sustainable Building Design Analysis:
    - Task: Students will analyze existing building designs and propose modifications for enhanced sustainability. They must assess the current electrical systems, recommend green technologies, and justify their choices based on energy efficiency and environmental impact.
    - Assessment Criteria: Evaluation will focus on the depth of analysis, creativity in proposing sustainable solutions, understanding of green technologies, and ability to articulate the environmental benefits of the proposed modifications.
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## Resources



## → Course Resources

- ◆ Electric Motor Controls, Text Manual Workbook, ATP Publishers
- ◆ Alerich, Electricity I, Delmar Publishers
- ◆ Alerich, Electricity II, Delmar Publishers
- ◆ Alerich, Electricity III, Delmar Publishers
- ◆ National Electrical Code, National Fire Protection Association
- ◆ Mullin, Electrical Wiring, Residential, Delmar Publishers, 2017 19th edition
- ◆ Stephen L. Herman, Electricity, Delmar Publishers, 1999, second edition
- ◆ John Cadick, Cables and Wiring, Delmar, 1999, second edition
- ◆ Richard A. Cox, Electricians Guide to Conduit Bending, Pend Orville Publications, 1982
- ◆ Dr. Chuck Wright, Blueprint Reading, NJATC, 1996
- ◆ NJATC, Mathematics Essential for NJATC, 1995, second edition
- ◆ Richard E. Loyd, Electrical Raceways and Other Wiring Methods, Delmar Publishers, 1999, 3rd edition
- ◆ NJATC, Applied Codeology, 1999
- ◆ John Wiles, Photovoltaic Power Systems and the National Electrical Code: Suggested Practices, Photovoltaic Systems Assistance Center, 1996
- ◆ NJATC, Air Conditioning and Refrigeration, 1990
- ◆ NJATC, Code Calculations, 2005
- ◆ George Patrick Shultz, Transformer and Motors, Newnes, 1989
- ◆ Harris Digital Telephone Systems, Harris Handbook on Basic Telephony, 1998
- ◆ Lester Leak, Basic Wiring Workbook, Vocational Marketing Services, 1996
- ◆ Mike Holt Understanding Basic Motor Controls 1974
- ◆ Michael Holt, Understanding the National Electrical Code, Delmar Publishers, 2005
- ◆ Michael Holt, Understanding the National Electrical Code/Workbook, Delmar Publishers, 2005

