



Program of Study Guide: **Electrical**

Comprehensive guidelines and course standards for the
Electrical pathway

Office of College and Career Pathways

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MARYLAND STATE DEPARTMENT OF EDUCATION

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Purpose

The purpose of this document is to communicate the required Career and Technical Education (CTE) academic standards for the Electrical Program of Study. The academic standards in this document are theoretical and performance based. The standards contain content from multiple state departments of education, industry related resources and have been reviewed and vetted by members of the Maryland business and industry community.

In addition to academic standards, the Maryland State Department of Education (MSDE) has incorporated into this document Labor Market Information (LMI) definitions and explanations for the Program of Study; program aligned Industry Recognized Credentials; and Work-Based Learning resources and requirements by course level.

Standards Sources

The following sources collectively support a progression of standards from foundational to advanced Electrical concepts in a high school context, preparing students for industry-aligned certifications like NCCER Electrical Level 1 and OSHA 30 and providing them with the necessary knowledge and skills for career readiness in Electrical fields.

Here are the key standards sources for electrical curriculum:

1. NCCER (National Center for Construction Education and Research)

- A. **Description:** Comprehensive competency-based craft training curriculum including Core curriculum and multiple levels of Electrical training. Includes detailed learning objectives, performance tasks, and assessment materials.
- B. **Use:** Provides the foundational structure for our program, including clear learning progressions and industry-recognized credentials. Aligned with industry needs and updated regularly.
- C. **Source:** Access through NCCER accredited training programs and approved curriculum providers (www.nccer.org)

2. National Electrical Code (NEC®) (*Latest version is an essential classroom resource)

- A. **Description:** Comprehensive electrical installation safety requirements and standards published by NFPA. Updated every 3 years with latest safety practices.
- B. **Use:** Critical for ensuring students learn current electrical codes and standards. Required knowledge for electricians and referenced throughout our curriculum.
- C. **Source:** Available through NFPA (www.nfpa.org) or licensed providers

3. NFPA 70E (Electrical Safety in the Workplace)

- A. **Description:** Credential that addresses electrical safety requirements for employees in the workplace.
- B. **Use:** Essential for teaching proper safety protocols and procedures for working with electrical systems.
- C. **Source:** Available through NFPA (www.nfpa.org)

4. OSHA Standards (29 CFR 1926 Subpart K)

- A. **Description:** Federal safety and health regulations for electrical safety in construction.
- B. **Use:** Ensures program meets required safety training standards and prepares students for workplace requirements.
- C. **Source:** Available at www.osha.gov

This document is intended for use by educational administrators and practitioners. A similar document is available for each state-approved CTE Program of Study.

Course Descriptions

Course Level	Course Information	Description
Required Core: Course 1	Core Construction Principles SCED: Pending Grades: 9-12 Prerequisite: None Credit: 1	Construction Fundamentals is a foundational course that introduces essential construction industry knowledge and skills while preparing students for careers in multiple construction trades. Students develop competencies in workplace safety, construction math, hand and power tools, construction drawings, and basic rigging. The course emphasizes comprehensive safety training aligned with OSHA 30 Construction certification requirements. Students also build crucial workplace readiness skills through modules on communication, employability, and material handling. Students can earn both NCCER Core and OSHA 30 Construction certifications upon completion.
Required Core: Course 2	Electrical I SCED: Pending Grades: 10-12 Prerequisite: Core Construction Principles Credit: 1	In Electrical Technology I, students learn skills necessary to pursue a career as an Electrician including an overview of occupations in the electrical industry, introduction to circuits, local, state and federal electrical code, residential wiring, and more. Additionally, students will learn to practice safe worksite protocols aligned with the Occupational Safety and Health Administration Construction 30-hour certification.
Optional Flex: Course 1	Electrical II SCED: Pending Grades: 11-12 Prerequisite: Electrical I Credit: 1	In Electrical Technology II, students will gain advanced knowledge and skills needed to enter the workforce as an electrician, electronic systems technician, or a supervisor; prepare for a postsecondary degree in a specified field of construction or construction management or pursue an approved apprenticeship program. Students will acquire knowledge and skills in safety, electrical theory, tools, codes, installation of electrical equipment, alternating current and direct current motors, conductor installation, installation of electrical services, and electric lighting installation.

Course Level	Course Information	Description
Optional Flex: Course 2	Career Connected Learning I SCED: Pending Grades: 11-12 Prerequisite: See Course Description Credits: 1-3	Prerequisites: - Alignment to the student's 6-Year Plan - Completion of: - Minimum two sequential courses in a CTE pathway, OR - Minimum two years of the same world language; OR - Minimum two sequential courses in a comprehensive arts program; OR - Inclusion in the IEP/504 transition plan with supporting documentation (as required) - Endorsement from an educator, mentor, employer, or career coach - No more than one course recovery credit in core subjects is needed by the student. This flexible, work-based learning course introduces students to real-world applications of classroom knowledge and technical skills through on-the-job experiences and reflective practices. Students engage in career exploration, skill development, and professional networking by participating in youth apprenticeships, registered apprenticeships, pre-apprenticeships, internships, capstone projects, or other approved career-connected opportunities. Variable credit (1–3) accommodates the required on-the-job training hours and related instruction. By integrating industry standards, employability skills, and personalized learning goals, Career Connected Learning I equips students to make informed career decisions, develop a professional portfolio, and build a strong foundation for success in postsecondary education, training, or the workforce.
Optional Flex: Course 3	Career Connected Learning II SCED: Pending Grades: 11-12 Prerequisite: Career Connected Learning I Credits: 1-3	Building on the foundational experiences of Career Connected Learning I, this advanced work-based learning course provides students with deeper on-the-job practice, leadership opportunities, and refined career exploration. Students continue to enhance their technical and professional skills, expanding their industry networks and aligning personal goals with evolving career interests. Variable credit (1–3) remains aligned with the required training hours and related instruction. Through elevated responsibilities and skill application, Career Connected Learning II prepares

Course Level	Course Information	Description
		students to confidently transition into higher-level postsecondary programs, apprenticeships, or the workforce.

Dual Enrollment and Career Connected Learning Experiences Must be Aligned to the CTE Core.

Industry-Recognized Credentials and Career-Connected Learning

The *Blueprint for Maryland's Future* and the High School Level of a Registered Apprenticeship

The Maryland State Department of Education recognizes the high-school level of a Registered Apprenticeship (RA), defined as a State-approved Registered Apprenticeship begun during high school in which students complete at least 144 hours of related technical instruction and 250 hours of paid on-the-job training before graduation, with the remaining required apprenticeship hours completed post-graduation, as the gold standard of Career Connected Learning.

The CTE Committee of the Governor's Workforce Development Board, in alignment with federal apprenticeship standards, requires 144 hours of RTI for all high school RA participants, and the Apprenticeship Maryland Program (AMP) defines the minimum RTI as **one course credit equivalent**. This high-school-level Registered Apprenticeship is the preferred career-connected learning option for students to meet the Blueprint's goal that 45% of public high school graduates complete either the high-school level of a Registered Apprenticeship or another industry-recognized credential.

To the extent practicable, the greatest number of students should achieve this goal through participation in a high-school level Registered Apprenticeship, with schools ensuring these requirements are scheduled, completed, and documented for transcript and reporting purposes.

To the extent practicable, the greatest number of students should achieve this goal through the high-school level of a Registered Apprenticeship.

Career-Connected Learning Resources		
Course 1: Career Awareness	Course 2: Career Preparation	Flex Courses: Career-Connected Learning
- Industry Visits - Guest Speakers - Participation in Career and Technical Student Organizations - Postsecondary Visits – Program Specific Site Tours - Mock Interviews	- All of Career Awareness plus the following: - Job Shadow - Employer Mentoring	- Registered Apprenticeship - Internship - School-Based Enterprise - Employer-Directed Capstone

Industry-Recognized Credentials – The standards in this document are aligned to the following certifications:

By the end of Core Construction Principles: NCCER Core

By the end of Electrical 1: NCCER Electrical Level 1 Certificate + OSHA 30

Optional Credentials (via the Flex Course options): Apprenticeship, NCCER Electrical Level 2 Certificate

Labor Market Information: Definitions and Data

Labor market information (LMI) plays a crucial role in shaping Career and Technical Education (CTE) programs by providing insights into industry demands, employment trends, and skills gaps. This data helps education leaders assess the viability of existing programs and identify opportunities for new offerings. By aligning CTE programs with real-time labor market needs, schools can better prepare students for in-demand careers and ensure that resources are effectively utilized to support pathways that lead to high-quality, sustainable employment.

Standard Occupational Code (SOC) and Aligned Industry:

Indicator	Definition	Pathway Labor Market Data
High Wage¹	Those occupations that have a 25th percentile wage equal to or greater than the most recent MIT Living Wage Index for one adult in the state of Maryland, and/or leads to a position that pays at least the median hourly or annual wage for the DC-VA-MD-WV Metropolitan Statistical Area (MSA). <i>Note: A 25th percentile hourly wage of \$24.74 or greater is required to meet this definition.</i>	Standard Occupational Code: 47-2111: Electricians Hourly Wage/Annual Salary: 25 th Percentile: \$24.30/\$50,544 50 th Percentile: \$31.56/\$65,645 75 th Percentile: \$43.91/\$91,333
High Skill	Those occupations located within the DC-VA-MD-WV Metropolitan Statistical Area (MSA) with the following education or training requirements: completion of an apprenticeship program; completion of an industry-recognized certification or credential; associate's degree, bachelor's degree, or higher.	Typical Entry-Level Education: Electricians need to be licensed in the State of Maryland. This can be accomplished by completing a Registered Apprenticeship program or going through an approved post-secondary education provider.
In-Demand	Annual growth plus replacement, across all Maryland occupations, is <u>405</u> openings between 2024-2029.	Annual Openings 1,470

Lightcast Data Updated August 2025

¹ Living Wage Calculator: <https://livingwage.mit.edu/states/24>

Labor Market Information Data Source

Lightcast occupation employment data are based on final Lightcast industry data and final Lightcast staffing patterns. Wage estimates are based on Occupational Employment Statistics (QCEW and Non-QCEW Employees classes of worker) and the American Community Survey (Self-Employed and Extended Proprietors). Occupational wage estimates are also affected by county-level Lightcast earnings by industry. Foundational data for the state of Maryland is collected and reported by the Maryland Department of Labor.

Methodology for High Wage Calculations

To combine labor market data across multiple Standard Occupational Classifications (SOCs), a weighted average approach was used to ensure accurate representation of the marketplace. Median wages for each SOC were weighted based on their respective employment levels, reflecting the relative demand for each occupation. This method ensures that occupations with higher employment contribute proportionately to the overall wage calculation. Additionally, job openings from all relevant SOCs were summed to determine the total projected demand. For example, if Mechanical Engineers account for 67% of total employment and Electrical Engineers for 33%, their respective wages are weighted accordingly, and job openings are aggregated to provide a comprehensive view of labor market opportunities. This approach delivers a balanced and accurate representation of both wages and employment demand for the program.

Methodology for In-Demand Calculations

The baseline for annual job openings, taking into account new positions and replacement positions, was determined by taking the average of all annual job openings between 2024 and 2029 across all 797 career sectors at the 5-digit SOC code level. For the 2024-2029 period, average job openings (growth + replacement) is 405.

Course Standards: Core Construction Principles

1. GENERAL REQUIREMENTS. This course is recommended for students in Grades 9-12.

2. INTRODUCTION

- A. Career and Technical Education (CTE) instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
- B. The Construction Career Cluster prepares students for careers in designing, planning, and building sustainable infrastructure. This field includes architects, engineers, construction managers, and skilled trades professionals.
- C. The Electrical Systems Technology program prepares students for careers in residential, commercial, and industrial electrical systems. Through a comprehensive curriculum aligned with industry standards, students develop foundational construction skills and specialized electrical knowledge while earning industry-recognized certifications. The program emphasizes hands-on learning, safety protocols, and real-world applications, preparing graduates for immediate entry into the electrical trade or advanced technical education.
- D. Core Construction Principles introduces students to the essential fundamentals of the construction industry with a focus on electrical systems career preparation. This foundational course aligns with NCCER Core certification and OSHA safety standards, emphasizing construction safety, basic math operations, hand and power tool operations, blueprint reading, and material handling. Students develop critical workplace skills through modules covering communication, employability skills, and construction drawings.
- E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
- F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.

3. KNOWLEDGE AND SKILLS

- A. The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
 - 1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.
 - 2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn.
 - 3. Employ effective reading, writing, and technical documentation skills.
 - 4. Solve problems using critical thinking techniques and structured troubleshooting methodologies.
 - 5. Demonstrate leadership skills and collaborate effectively as a team member.
 - 6. Implement safety procedures, including proper handling of hardware and following OSHA guidelines.
 - 7. Exhibit an understanding of legal and ethical responsibilities in the construction field, following applicable laws and best practices for safety.

8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting.

B. The student identifies various career pathways in the Electrical field. The student is expected to:

1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles as an Electrician or in the electrical field.
2. Create a professional resume and portfolio that reflect skills, projects, certifications, and recommendations.
3. Demonstrate effective interview skills for roles in the electrical field.

C. The student identifies the issues associated with electrical hazards found on a jobsite. The student is expected to:

1. Demonstrate safe working procedures in a construction environment.
2. Explain the purpose of the Occupational Safety and Health Administration (OSHA) and how it promotes safety on the job.
3. Identify electrical hazards and how to avoid or minimize them in the workplace.
4. Explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection.

D. The student integrates core academic skills into electrical construction practices. The student is expected to:

1. Demonstrate the use of clear communication techniques, both written and verbal, that are consistent with industry standards.
2. Apply mathematical concepts such as operations with whole numbers, fractions, and decimals; working with geometric shapes and calculating their areas/volumes; measurement using both metric and imperial units; converting between measurement systems; working with scale drawings (architectural, engineering, and metric scales); calculating load values and equivalent resistance in electrical circuits; and determining proper sizing for electrical components based on mathematical formulas.
3. Use scientific principles including electrical theory (atomic structure, conductors/insulators, circuit behavior, Ohm's Law), materials science (properties of electrical materials, material strength), physical science (mechanical advantage, force and motion), and human factors engineering (ergonomics, physiological effects of electricity, respiratory protection), which are all essential for understanding and safely performing electrical and construction work.

E. The student demonstrates understanding of construction industry fundamentals and career opportunities. The student is expected to:

1. Analyze the current state and key career fields within Electrical related careers.
2. Evaluate the benefits and opportunities available in a construction career.
3. outline the typical career progression path for craft professionals.
4. Develop a plan to pursue a career in the Electrical field.

F. The student implements construction safety protocols and procedures. The student is expected to:

1. Analyze workplace incidents, associated costs, and methods to reduce hazards;
2. Demonstrate proper fall protection techniques and hazard prevention methods.

3. Identify and mitigate struck-by and caught-in-between hazards and apply safety practices for common job-site hazards.
4. Evaluate electrical hazards and implement appropriate safety measures.
5. Select and utilize appropriate personal protective equipment (PPE) for specific hazards.

G. The student applies mathematical principles in construction contexts. The student is expected to:

1. Solve basic arithmetic problems using whole numbers.
2. Calculate measurements and dimensions using fractions.
3. Solve construction-related math problems with precision.
4. Measure lengths accurately using common measuring tools.
5. Convert between units of measurement in both imperial and metric systems.
6. Calculate areas and volumes of common geometric shapes.

H. The student demonstrates proper use and maintenance of hand tools. The student is expected to:

1. Identify and safely operate common hand tools.
2. Select and utilize appropriate measurement and layout tools.
3. Maintain and properly store hand tools common to construction sites.

I. The student demonstrates safe and proper use of power tools. The student is expected to:

1. Identify the tool most appropriate for the job to be performed.
2. Operate industry related tools safely and effectively.
3. Perform maintenance on related industry tools.
4. Demonstrate appropriate storage and safety techniques when tools are not in use.

J. The student interprets construction drawings and specifications. The student is expected to:

1. Identify basic components and features of construction drawings, schematics, and diagrams.
2. Differentiate between various types of construction drawings.

K. The student develops effective workplace communication skills. The student is expected to:

1. Demonstrate effective verbal and non-verbal communication in construction settings.
2. Apply reading and writing skills to construction-related tasks.

L. The student develops professional workplace behaviors and skills. The student is expected to:

1. Understand the importance of consistent attendance, punctuality, and professional communication.
2. Evaluate construction business opportunities and workforce entry strategies.
3. Apply critical thinking skills to solve workplace problems.
4. Demonstrate appropriate social skills in professional settings to include customer service interactions that communicate the problem, potential solutions, and create positive customer experiences.

M. The student implements proper material identification & handling techniques. The student is expected to:

1. Identify and explain specific uses for different industry related materials.
2. Apply safety precautions in material handling operations.
3. Select and operate appropriate material handling equipment.

Course Standards: Electrical I

1. **GENERAL REQUIREMENTS.** This course is recommended for students in Grades 10-12.
2. **INTRODUCTION**
 - A. Career and Technical Education (CTE) instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Construction Career Cluster prepares students for careers in designing, planning, and building sustainable infrastructure. This field includes architects, engineers, construction managers, and skilled trades professionals.
 - C. The Electrical program prepares students for careers in residential, commercial, and industrial electrical systems. Through a comprehensive curriculum aligned with industry standards, students develop foundational construction skills and specialized electrical knowledge while earning industry-recognized certifications. The program emphasizes hands-on learning, safety protocols, and real-world applications, preparing graduates for immediate entry into the electrical trade or advanced technical education.
 - D. Electrical I builds upon core construction knowledge to introduce students to fundamental electrical theory and hands-on applications in the electrical trade. Students explore electrical safety protocols, circuit theory, and residential wiring practices while developing proficiency in electrical tool and test equipment operation. The course emphasizes proper interpretation of the National Electrical Code® and electrical construction documentation. Through hands-on practice, students learn essential skills including conduit bending, electrical box installation, and cable and conductor installation. Upon successful completion, students may be prepared for NCCER Electrical Level 1 (or similar industry related) certification, establishing their foundation for advancement in the electrical trade.
 - E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
 - F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.
3. **KNOWLEDGE AND SKILLS**
 - A. The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
 1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.
 2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn.
 3. Employ effective reading, writing, and technical documentation skills.
 4. Solve problems using critical thinking techniques and structured troubleshooting methodologies.
 5. Demonstrate leadership skills and collaborate effectively as a team member.

6. Implement safety procedures, including proper handling of hardware and following OSHA guidelines.
7. Exhibit an understanding of legal and ethical responsibilities in the construction field, following applicable laws and best practices for safety.
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting.

B. The student identifies various career pathways in the Electrical field. The student is expected to:

1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles as an Electrician or in the electrical field.
2. Create a professional resume and portfolio that reflect skills, projects, certifications, and recommendations.
3. Demonstrate effective interview skills for roles in the electrical field.

C. The student identifies the issues associated with electrical hazards found on a jobsite. The student is expected to:

1. Demonstrate safe working procedures in a construction environment.
2. Explain the purpose of the Occupational Safety and Health Administration (OSHA) and how it promotes safety on the job.
3. Identify electrical hazards and how to avoid or minimize them in the workplace.
4. Explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection.

D. The student integrates core academic skills into electrical construction practices. The student is expected to:

1. Demonstrate the use of clear communication techniques, both written and verbal, that are consistent with industry standards.
2. Apply mathematical concepts such as calculating with whole numbers, fractions, and decimals; measuring lengths and converting between measurement systems; calculating geometric areas and volumes; applying Ohm's law and Kirchhoff's laws to solve for circuit values; and performing electrical load calculations for residential systems including demand factors and service sizing.
3. Use scientific principles include atomic structure and its relationship to electricity, magnetism in electrical devices, principles of conductors and insulators, electrical theory (including Ohm's Law and Kirchhoff's Laws), effects of electrical shock on the human body, and principles of circuit behavior in series and parallel configurations.

E. The student explores career opportunities and responsibilities in the electrical industry. The student is expected to:

1. Analyze various sectors and trade options within the electrical industry.
2. Evaluate the roles and responsibilities of employees and employers in electrical related fields.

F. The student implements job site and electrical safety protocols and procedures. The student is expected to:

1. Analyze electrical hazards and their effects on human safety.

2. Evaluate how personal protective equipment (PPE) mitigates injury risk.
3. Research standards and regulations related to electrical safety.
4. Apply appropriate safety requirements for various electrical hazards.
5. Understand appropriate lift operating techniques.
6. Understand safety requirements (OSHA) for trenching and excavation as they apply to electrical work.
7. Demonstrate proper utility location identification techniques and the role of Miss Utility.

G. The student understands fundamental electrical principles and circuit analysis. The student is expected to:

1. Explain atomic structure and its relationship to electrical principles.
2. Calculate circuit values using appropriate electrical equations.
3. Interpret simple schematic diagrams of electrical circuits.
4. Solve for various values in resistive circuits.
5. Demonstrate the application of Ohm's and Kirchhoff's laws in different circuit types.

H. The student implements proper installation of electrical boxes and enclosures. The student is expected to:

1. Calculate appropriate sizing and demonstrate installation of outlet boxes.
2. Calculate appropriate sizing and demonstrate installation of pull and junction boxes.
3. Demonstrate proper navigation and application of the NEC® to this content.

I. The student demonstrates conduit installation and modification techniques. The student is expected to:

1. Demonstrate methods for cutting, reaming, and threading conduit.
2. Apply appropriate methods for hand bending EMT and PVC conduit.

J. The student implements various electrical containment systems. The student is expected to:

1. Demonstrate proper selection and installation of raceway systems.
2. Select and install appropriate fasteners and anchors for raceway systems.
3. Demonstrate selection and installation of wireways and specialty raceways.
4. Apply proper techniques for cable tray selection and installation.
5. Execute proper handling and storage procedures for raceways.
6. Demonstrate proper navigation and application of the NEC® to this content.

K. The student demonstrates knowledge of electrical conductors and their applications. The student is expected to:

1. Analyze conductors based on wire size, insulation, and application requirements.
2. Demonstrate proper installation techniques for conductors in conduit systems.
3. Demonstrate proper navigation and application of the NEC® to this content.

L. The student interprets electrical construction documentation. The student is expected to:

1. Describe the types of drawings usually included in a set of plans and list the information found on each type.
2. Identify the different types of lines used on construction drawings.
3. Identify selected architectural symbols commonly used to represent materials on plans.
4. Identify selected electrical, mechanical, and plumbing symbols commonly used on plans.

5. Identify selected abbreviations commonly used on plans.
6. Read and interpret plans, elevations, schedules, sections, dimensions/measurements and other details contained in basic construction drawings.
7. State the purpose of written specifications.
8. Identify and describe the parts of a specification.
9. Demonstrate and/or describe how to create a materials list based on drawings/specifications.

M. The student demonstrates residential electrical installation techniques. The student is expected to:

1. Calculate appropriate electric service size for residential applications.
2. Apply proper grounding requirements for residential electrical systems.
3. Demonstrate installation techniques for service-entrance equipment.
4. Select appropriate wiring methods for various residential applications.
5. Design and size branch circuits and outlet boxes.
6. Select and install various wiring devices according to specifications.
7. Demonstrate proper navigation and application of the NEC® to this content.

N. The student utilizes electrical testing equipment safely and effectively. The student is expected to:

1. Evaluate different types of electrical test equipment for specific applications.
2. Apply appropriate safety requirements based on meter category ratings.

Course Standards: Electrical II

1. **GENERAL REQUIREMENTS.** This course is recommended for students in Grades 11-12.
2. **INTRODUCTION**
 - A. Career and Technical Education (CTE) instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Construction Career Cluster prepares students for careers in designing, planning, and building sustainable infrastructure. This field includes architects, engineers, construction managers, and skilled trades professionals.
 - C. The Electrical Systems Technology program prepares students for careers in residential, commercial, and industrial electrical systems. Through a comprehensive curriculum aligned with industry standards, students develop foundational construction skills and specialized electrical knowledge while earning industry-recognized certifications. The program emphasizes hands-on learning, safety protocols, and real-world applications, preparing graduates for immediate entry into the electrical trade or advanced technical education.
 - D. Electrical II extends students' foundational electrical skills into advanced principles and industry practices. Learners develop and apply knowledge of alternating current theory, power calculations, and transformer operations. The course emphasizes lighting systems, including selection and installation of luminaires, and advances conduit bending proficiency—covering both manual and powered methods in accordance with NEC® requirements. Students master the sizing and installation of pull and junction boxes, cable tray systems, cable pulling techniques, and secure conductor terminations and splices. Hands-on exploration of grounding, bonding, and control systems—including contactors, relays, and lighting controls—prepares students for real-world scenarios and troubleshooting. Successful completion begins preparation for NCCER Electrical Level 2 (or comparable) certification and progression into apprenticeship or advanced coursework in the electrical trade.
 - E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
 - F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.
3. **KNOWLEDGE AND SKILLS**
 - A. **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
 1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.
 2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn.
 3. Employ effective reading, writing, and technical documentation skills.
 4. Solve problems using critical thinking techniques and structured troubleshooting methodologies.

5. Demonstrate leadership skills and collaborate effectively as a team member.
6. Implement safety procedures, including proper handling of hardware and following OSHA guidelines.
7. Exhibit an understanding of legal and ethical responsibilities in the construction field, following applicable laws and best practices for safety.
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting.

B. The student identifies various career pathways in the Electrical field. The student is expected to:

1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles as an Electrician or in the electrical field.
2. Create a professional resume and portfolio that reflect skills, projects, certifications, and recommendations.
3. Demonstrate effective interview skills for roles in the electrical field.

C. The student identifies the issues associated with electrical hazards found on a jobsite. The student is expected to:

1. Demonstrate safe working procedures in a construction environment.
2. Explain the purpose of the Occupational Safety and Health Administration (OSHA) and how it promotes safety on the job.
3. Identify electrical hazards and how to avoid or minimize them in the workplace.
4. Explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection.

D. The student integrates core academic skills into electrical construction practices. The student is expected to:

1. Demonstrate the use of clear communication techniques, both written and verbal, that are consistent with industry standards.
2. Apply mathematical concepts such as calculating with whole numbers, fractions, and decimals; measuring lengths and converting between measurement systems; calculating geometric areas and volumes; applying Ohm's law and Kirchhoff's laws to solve for circuit values; and performing electrical load calculations for residential systems including demand factors and service sizing.
3. Use scientific principles include atomic structure and its relationship to electricity, magnetism in electrical devices, principles of conductors and insulators, electrical theory (including Ohm's Law and Kirchhoff's Laws), effects of electrical shock on the human body, and principles of circuit behavior in series and parallel configurations.

E. The student understands alternating current principles and applications. The student is expected to:

1. Analyze AC waveform characteristics and behavior.
2. Calculate unknown values in AC circuits using appropriate formulas.
3. Solve power calculation problems in AC circuits.
4. Evaluate transformer operation and characteristics.

F. The student analyzes electric lighting principles and applications. The student is expected to:

1. Explain the relationship between human vision and artificial lighting.
2. Evaluate and select appropriate light sources and luminaires for specific applications.
3. Demonstrate proper selection and installation of luminaires for various settings.

G. The student performs conduit bending operations. The student is expected to:

1. Apply NEC® requirements for conduit bends.
2. Calculate proper bend distances using mathematical formulas.
3. Demonstrate proper use of mechanical benders.
4. Operate electric and hydraulic conduit benders safely and effectively.
5. Install PVC conduit according to specifications.

H. The student installs and sizes pull and junction boxes. The student is expected to:

1. Identify appropriate boxes and fittings for specific applications.
2. Calculate proper sizing for pull and junction boxes.
3. Select and install specialty enclosures correctly.

I. The student demonstrates proper conductor installation techniques. The student is expected to:

1. Install cable in conduit systems according to specifications.
2. Set up and perform high-force cable pulls safely.
3. Evaluate and observe cable limitations during pulling operations.

J. The student understands cable tray systems and installations. The student is expected to:

1. Identify and select appropriate cable tray components.
2. Calculate cable tray load requirements.
3. Determine proper cable tray fill limitations.

K. The student performs conductor terminations and splices. The student is expected to:

1. Demonstrate proper conductor stripping and training techniques.
2. Make secure and reliable wire connections.
3. Apply proper insulation methods for electrical connections.

L. The student demonstrates knowledge of grounding and bonding principles. The student is expected to:

1. Apply grounding requirements for various applications.
2. Install service grounding according to approved methods.
3. Size and select appropriate equipment grounding conductors and components.
4. Demonstrate proper bonding of service equipment.
5. Install grounding and bonding for separately derived systems.
6. Perform effective ground testing procedures.

M. The student demonstrates understanding of control systems. The student is expected to:

1. Wire and test magnetic and mechanically held contactors.
2. Troubleshoot various types of relay systems.
3. Install and configure low-voltage lighting control systems.