**Course Description:**

This course will emphasize electrical theory, materials, equipment and general methods used in residential construction. Students will navigate the National Electrical Code, learn worksite safety and understand licensing and permitting requirements. They will interpret plans and job specifications and calculate loads and service requirements. Students will install, test and repair receptacle outlet, lighting and small appliance circuits. They will understand circuit protection concepts and install a subpanel. Specialty circuit installation will be addressed.

**Strand 2. Safety, Tools, and Equipment**

Learners apply principles of protection, prevention and mitigation to create and maintain safe working conditions at construction sites. Knowledge and skills may be applied in all aspects of personal and site safety, including handling materials, using tools and equipment, working with and around electricity, using personal protective equipment and operating heavy equipment.

**Outcome 2.1. Site Safety**

Handle materials, prevent accidents and mitigate hazards.

**Competencies**

2.1.1. Use Occupational Safety and Health Administration (OSHA)‐defined procedures for identifying

employer and employee responsibilities, working in confined spaces, managing worker safety

programs, using ground fault circuit interrupters (GFCIs), maintaining clearance and

boundaries and labeling.

2.1.2. Identify and rectify or mitigate construction hazards associated with thresholds, slippery

surfaces and lighting.

2.1.3. Calculate an example of load factors for constructing scaffolding, railings, ladders and

temporary structures.

2.1.6. Identify the source of electrical hazards and use shutdown and established lock‐out/tag‐out

procedures.

2.1.7. Identify and eliminate worksite clutter in accordance with standards for cleanliness and safety.

2.1.8. Identify procedures for the handling, storage and disposal of hazardous materials.

2.1.9. Identify the location of emergency flush showers, eyewash fountains, Safety Data Sheets

(SDSs), fire alarms and exits.

2.1.10. Select and operate fire extinguishers based on the class of fire.

2.1.11. Identify the components of a hazardous materials safety plan.

2.1.12. Create a hazardous materials safety plan.

2.1.13. Set up for ergonomic workflow.

*An “X” indicates that the pathway applies to the outcome.*

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| Pathways | X | Design | X | Mechanical, Electrical, Plumbing | X | Structural |

**Outcome 2.2. Personal Safety**

Practice personal safety in construction.

**Competencies**

2.2.1. Interpret personal safety rights according to the employee Right‐to‐Know plan.

2.2.2. Describe how working under the influence of drugs and alcohol increases the risk of accident,

lowers productivity, raises insurance costs, and reduces profits.

2.2.3. Select, use, store, maintain and dispose of personal protective equipment (PPE) appropriate

to job tasks, conditions and materials.

2.2.4. Identify workplace risk factors associated with lifting, operating and moving heavy objects

and establish an ergonomics process.

2.2.5. Identify, inspect and use safety equipment appropriate for the task.

2.2.6. Demonstrate first aid and cardiopulmonary resuscitation (CPR).

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**Outcome 2.4. Equipment and Machinery Preventative Maintenance**

Clean, maintain and perform planned preventative maintenance (PPM) on equipment and machinery.

**Competencies**

2.4.1. Lubricate machinery and equipment.

2.4.2. Ensure the presence and functionality of safety systems and hardware.

2.4.3. Service electrical systems (e.g., fuses, bulbs).

2.4.4. Perform machine adjustments (e.g., belts, drive chains).

2.4.5. Service filtration systems.

2.4.6. Identify, select and maintain fluid levels.

2.4.7. Maintain instrument, machinery and equipment cleanliness, appearance and safety devices.

2.4.8. Inspect and maintain fluid conveyance and storage components (e.g., hoses, lines, valves,

nozzles).

2.4.9. Calibrate metering, monitoring, and sensing equipment.

2.4.10. Inspect and maintain tooling and implements.

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**Strand 4. Electrical**

Learners apply principles of electricity and knowledge of building codes to construct systems to generate and deliver power in residential, commercial and industrial applications. Knowledge and skill may be applied to rough‐in and finish wiring, motors and power wiring, specialized low‐voltage systems, alternative power systems, power transmission, plant operations and coal equipment.

**Outcome 4.1. Electrical Theory**

Explain electrical principles and theories.

**Competencies**

4.1.1. Explain atomic structure and its relationship to electricity.

4.1.2. Describe the relationship between electrical effect and electromagnetic effect.

4.1.3. Explain methods of producing electrical current.

4.1.4. Describe the differences between alternating current (AC) and direct current (DC).

4.1.5. Compare and contrast conductors and insulators.

4.1.6. Describe the relationships between voltage, current, resistance and power in circuits.

4.1.7. Calculate voltage, current, resistance, impedance and power in circuits using Ohm’s Law,

Kirchhoff’s Law and Watt’s Law.

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**Outcome 4.2. Circuits**

Analyze and evaluate direct current (DC) circuits and alternating current (AC) circuits.

**Competencies**

4.2.1. Identify electrical, electromechanical and solid state controls.

4.2.2. Describe the purpose of grounding and common methods used for grounding.

4.2.3. Analyze wiring schematics and diagrams to troubleshoot circuits.

4.2.4. Explain the uses of series, parallel and series‐parallel circuits.

4.2.5. Construct and troubleshoot series, parallel and series‐parallel circuits.

4.2.6. Determine voltage, current, frequency and phase.

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| Pathways | X | Design | X | Mechanical, Electrical, Plumbing | X | Structural |

**Outcome 4.3. Codes and Regulations**

Explain and apply the National Electrical Code (NEC) and other building codes.

**Competencies**

4.3.1. Explain the role of Underwriters Laboratory (UL), Canadian Standards Association (CSA) and

Intertek Testing Service/Edison Testing Laboratory (ITS/ETL).

4.3.2. Locate and apply the information in articles of the NEC and other applicable codes (i.e.,

Building Officials and Code Administrators [BOCA], Ohio Building Code [OBC], Life Safety

Codes) and explain how they impact job requirements (e.g., service conductors, feeders,

branch circuits, overload protection, grounding and bonding requirements).

4.3.3. Utilize National Fire Protection Association (NFPA) procedures for NFPA 70E‐arc flash

boundaries, current‐limiting fuses, live work power permits, electrically safe work

conditions, emergency worker safety programs, scheduling, energized circuits and training.

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**Outcome 4.4. Low Voltage Systems**

Describe specialized low‐voltage systems and components.

**Competencies**

4.4.1. Identify and describe types of data and communication systems.

4.4.2. Identify and describe local, state and National Electrical Code (NEC) requirements for the

installation of security and fire alarm systems.

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**Outcome 4.5. Electrical Wiring**

Install wiring in residential, commercial, and industrial settings in both above‐ground and below‐ground applications.

**Competencies**

4.5.1. Select materials and lay out rough‐in wiring runs according to specifications, drawings and

code requirements.

4.5.2. Identify and install fasteners, anchors, and fire stop systems.

4.5.3. Locate and mount boxes.

4.5.4. Verify the location of and install service entrance systems.

4.5.5. Install service panels, meter apparatus, grounding electrode systems, subpanels and over

current protective devices.

4.5.6. Identify and label a panel directory to reflect devices and circuits installed on each circuit.

4.5.7. Lay out and install conduit or cable runs, raceways and cable systems (e.g., electrical metallic

tubing [EMT], galvanized rigid conduit [GRC], intermediate metal conduit [IMC], polyvinyl

chloride [PVC], electrical nonmetallic tubing [ENT or ENMT], armored cable [AC], metal clad

cable [MC]).

4.5.8. Install rough‐in wiring following specifications, drawings and code requirements.

4.5.9. Identify the pull needed for conductors according to specifications, drawings and code

requirements.

4.5.11. Install lighting fixtures, wiring devices and covers.

4.5.12. Install equipment grounding and bonding systems.

4.5.13. Make conductor terminations.

4.5.14. Connect appliances.

4.5.15. Check and test installation.

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**Strand 6. Planning and Design**

Learners apply principles of architectural and civil engineering, drawing and construction with current technology to develop, present and use construction proposals, plans and schematics. Knowledge and skill may be applied throughout the project from preconstruction design through all stages of building in residential, commercial and industrial applications.

**Outcome 6.4. Construction Drawings**

Read and interpret plans and diagrams within a construction drawing set (i.e., topographical, grading and drainage, architectural, structural, plumbing, mechanical, electrical) to organize a project work sequence.

**Competencies**

6.4.1. Collect and analyze project information to determine resources and tasks required to

complete a project.

6.4.2. Read and interpret a site plan.

6.4.3. Use architect’s and engineer’s scales to read and interpret construction drawings for material

calculations and installation at the jobsite.

6.4.4. Read, interpret, and organize construction drawings, specifications and other contractual

documents.

*An “X” indicates that the pathway applies to the outcome.*

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| Pathways | X | Design | X | Mechanical, Electrical, Plumbing | X | Structural |

**Outcome 6.5. Construction Math**

Calculate materials needed to complete construction projects.

**Competencies**

6.5.1. Find surface area and volume for three‐dimensional objects, accurate to a specified level of

precision.

6.5.2. Apply measurement scales to layout length, width, and angle measurements.

6.5.3. Apply algebraic procedures and geometric concepts to reading construction documents.

6.5.4. Use proportional reasoning and apply indirect measurement techniques (e.g., right triangle

trigonometry, properties of similar triangles).

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| Pathways | X | Design | X | Mechanical, Electrical, Plumbing | X | Structural |