WTCS Repository
Program Design Summary & Curriculum Standards Model [2015-16]

50-413-6 ELECTRIC LINE APPRENTICE

Program Information

Instructional Level	Technical Diploma & Apprenticeship
Career Cluster	Agriculture, Food and Natural Resources
CIP Code	46.0303

Description

This four year Electric Lineworker Apprenticeship Program provides each apprentice with 8,000 hours of training in the field of electrical power distribution and related subjects which includes 7,360 hours of on-the-job training and 640 hours of related instruction. During the related instruction portion of the apprenticeship program, both overhead and underground distribution systems will be explored along with electrical theory and skill development in critical work processes.

Direct current theory and Ohm's Law will be explored as it relates to series, parallel, and combination circuits and its' practical applications for transmission and distribution lines. Distribution line specifications of overhead transmission and distribution power lines will be explored. Accident analysis and the critique of distribution and transmission safety practices will be examined using scenarios. The use and demonstration of climbing tools will be covered. Basic rigging knots and the use of safe rigging procedures will be explored and put to practical use. Safe chain saw operation and maintenance will be demonstrated for field work. Bucket truck and digger truck set-up, safety and operations will be performed.

Aluminum and copper conductor fundamentals will be covered with the calculation of voltage drop and paralleling conductor concepts. Single phase 3 wire service fundamentals will be explored so that you can predict, assess, and then trouble-shoot problems. The National Electric Safety Code (NESC) and Wisconsin Administrative Code Chapters 113 and 114 will be studied at length and apprentices will recite rules as they apply to the electric power industry.

Renewable distributed generation (RDG) is becoming more and more common in the electric distribution, generation, and transmission fields, especially as the price of energy continues to rise. Lineworkers will need to understand renewable energy generation, alternative power, smart grids, and more. “Green energy” modules that help the apprentice better understand and analyze system components, equipment, system design, interrelationships between components and technical information are included. The program is a progressive training program for electric utility distribution workers, and learning outcomes include both the fundamentals of electricity and skill development in critical trade work processes.

External Requirements (Wisconsin DWD-BAS)

The following external requirements are approved by the Wisconsin DWD-Bureau of Apprenticeship Standards:

•4 year training program
•8,000 hours on-the-job training
•640 hours paid related instruction
•Apprentice must complete Red Cross First Aid and CPR courses and maintain certification throughout the apprenticeship
•Apprentice must in his/her final year complete the Transition-To-Trainer Course.

Trade Work Processes:

- Electric line workers install, remove, maintain, and repair electric overhead and underground distribution, sub-transmission, and transmission systems.
- They respond to 24 hour call out to restore electric service and ensure safety for protection of public and crews.
- Install/repair poles, wire and electrical equipment associated with overhead electrical distribution and transmission systems.
- Install/repair underground cable and electrical equipment associated with electrical distribution and transmission systems.
- Ensure public and crew safety, including: personal protection equipment and emergency procedures and training.
- Remain current with all construction, maintenance, safety and work methods, specifications, materials and practices.
- Drive a variety of motor vehicles and operates hydraulic equipment; for example: back hoe trenchers, bucket trucks and digger derricks.
- Use a variety of hand tools, including chain saws, shovels, drills and compression tools.
- Maintain electronic and paper records, reports, etc.

WTCS Program Outcomes

1	Use mathematics related to the electrical trade problem-solving
2	Apply essential fundamentals of electricity as related to electrical distribution systems
3	Illustrate electrical circuits and components with acceptable drawings and sketches effectively and accurately
4	Apply state utility and National Electrical Safety Codes
5	Install electrical distribution systems, equipment and components
6	Operate electrical distribution systems, equipment and components
7	Repair electrical distribution systems, equipment and components
8	Maintain electrical distribution systems, equipment and components
9	Perform in a skilled and knowledgeable manner, and function as a journeyman lineman
10	Accept responsibility for the safety of yourself and those working around you
11	Integrate new and emerging green technologies into the trade and industry
12	Troubleshoot equipment and utility electrical systems

Program Configuration Models

50-413-6 Electric Line Worker Apprenticeship Related Instruction [2015-16]

Description

This program configuration model provides curriculum standards and a sequence of courses for related instruction across the WTCS colleges. The model includes the following:

- 640 hours of related instruction
- 40 hour 1-week block scheduled courses with 2 blocks per term and 8 terms
- 8 courses x 2.25-credits/course at 80 hours
- Transition to Trainer included in the last year of the apprenticeship
- Other: OSHA, CDL, CPR, First Aid, and other employer required training varies by employer

Credits & Hours

1 - Occupation Specific	17.75 credits @ 36 hours per credit
2 - Occupation Supportive	0.00 credits & 8 hours (Transition to Trainer)
Total Credits	**17.75 credits & 640 hours**

Year 1 Term 1

Course #	Course Title	Credits & Hours	Course Description & Prerequisites
50-413-711	**Safety, Hazard Awareness, DC Electrical Theory & Orientation to the Trade**	2.25 80 hours	This course is designed to orient apprentices to the basics of electric power distribution systems and the work processes performed by line workers. Course competencies include basic DC electrical theory and their applications. Safety requirements and safe work practices will be taught and reinforced during hands-on learning activities at the school. Students will learn to identify job site hazards. The DC electrical theory unit will explore wire sizing, grounding, and VOM meter use. Climbing techniques and safety are included; along with arc flash prevention, fall protection, and work positioning equipment safety. Course provides two weeks of related instruction in a block scheduling format. *Prereq: registered apprentice.*

Year 1 Term 2

Course #	Course Title	Credits & Hours	Course Description & Prerequisites
50-413-712	**Electrical Theory 2, Codes & Overhead Construction**	2.25 80 hours	Course examines the National Electric Safety Codes & Wisconsin PSC rules and regulations. In addition, competencies related to solving electrical problems, parallel and series circuits, power factors, circuit protection, metering, grounding, power quality and renewable energy are included. Apprentices will also build skills with using meters and test equipment. Apprentices will build skills applying OSHA 1910.269 and other safety requirements to troubleshooting equipment and components. Course provides two weeks of related instruction in a block scheduling format. *Prereq: 50-413-711 is suggested.*

Year 2 Term 1 (Term 3)

Course #	Course Title	Credits & Hours	Course Description & Prerequisites
50-413-713	**AC Electrical Theory, Generation and Distribution Fundamentals, Voltage Regulation and Power Quality**	2.25 80 hours	Course competencies and learning objectives include an introduction to AC electrical theory and its applications; an examination of Ohm's Law and related principles; concepts pertaining to generation & distribution of AC energy; inductors and electric apparatus & equipment. A review of 1st Year and OSHA 1910.269 safety requirements are included. Course provides two weeks of related instruction in a block scheduling format. *Prereq: 50-413-712 and/or successful completion of first year is suggested*

Year 2 Term 2 (Term 4)

Course #	Course Title	Credits & Hours	Course Description & Prerequisites
50-413-714	**Underground Distribution Systems & Electrical Codes**	2.25 80 hours	Course competencies and learning objectives examine the Wisconsin Administrative Codes and PSC rules and regulations, equal-potential grounding, handling energized and de-energized cables and troubleshooting open neutral problems. Apprentices will explore lightning arrestors, smart grid technologies, and street light maintenance and installation. Underground distribution related competencies will focus on schematics, cable locating, fault detection, insulated cables, grounding practices, construction techniques, and maintenance. Applicable OSHA 1910.269 requirements and PSC rules and regulations are reviewed. Course provides two weeks of related instruction in a block scheduling format. *50-413-713 is a suggested prerequisite*.

Year 3 Term 1 (Term 5)

Course #	Course Title	Credits & Hours	Course Description & Prerequisites
50-413-715	**Single Phase Equipment & Energized Line Safe Work Practices**	2.25 80 hours	Apprentices will examine more of the National Electrical Safety Code and compare overhead construction techniques for primary and secondary lines. Course competencies also include concepts and principles associated with single phase power, equipment, and safe work practices for energized lines. Training in confined space entry and aerial rescue will be included in this course. Course provides 2 weeks of related instruction in a block scheduling format. *50-413-714 and successful completion of years 1 and 2 is a suggested pre-requisite.*

Year 3 Term 2 (Term 6)

Course #	Course Title	Credits & Hours	Course Description & Prerequisites
50-413-716	**Poly Phase Equipment & Construction**	2.25 80 hours	Course examines poly phase equipment, apparatus and construction. Course competencies explore transformers, grounding requirements, load calculations, safety, and related concepts. OSHA 1910.269 and a review of 1st & 2nd years are included. Course provides 2 weeks of related instruction in a block schedule format. *50-413-715 and successful completion of*

			first and second years is a suggested pre-requisite.

Year 4 Term 1 (Term 7)

Course #	Course Title	Credits & Hours	Course Description & Prerequisites
50-413-717	**Poly Phase Power Fundamentals, Substations, and Metering**	2.25 80 hours	Competencies and learning objectives in this course include three phase power; banking operations, safety; back-feeds; and high voltage. A transformer apparatus school and overhead school are included. Applicable OSHA 1910.269 requirements are reviewed and practiced. This course also examines energized line work, substation operations and switching, three-phase metering applications and green energy power generation equipment or systems. A review of applicable OSHA 1910.269 requirements and years 1-3 of related instruction are included. Customer service skills are reinforced and applied to roles for line workers. Course provides 2 weeks of related instruction in a block scheduling format. *50-413-716 and successful completion of years 1, 2 and 3 is suggested pre-requisite.*

Year 4 Term 2 (Term 8)

Course #	Course Title	Credits &	Course Description & Prerequisites
50-413-718	**Emergency Response for Line Workers & Renewable Energy Capstone Projects**	2.00 72 hours	Course competencies and learning objectives focus on emergency response roles for line workers and preparing the apprentice for a transition to journey level work. A hands-on learning activity involving a car/pole accident response simulation provides for capstone project learning experiences. Course also reviews for the JW exam offered through the college. Apprentices will complete a renewable & green energy research project and presentation as a second capstone learning experience. The Transition to Trainer course is also taught during this term. Course provides 2 weeks of related instruction in a block scheduling format. *50-413-717 and successful completion of years 1, 2 and 3 are suggested pre-requisites.*
47-455-455	**Transition to Trainer: Your Role as a Journey Worker**	0.00 8 hours	You have already learned to use the tools of your chosen trade. In this workshop you will be introduced to a new set of basic tools--the tools of a jobsite trainer. You will explore the skills that are necessary to be an effective trainer, discover how to deliver hands-on training, and examine the process for giving useful feedback. During the workshop you will build a Training Toolkit to take back to your work on the job.

Other Related Instruction as required

Course #	Course Title	Credits	Course Description & Prerequisites
Varies	**CPR, First Aid & other employer requirements**	0.00	2 - Occupation Supportive
Varies	**OSHA Training as required**	0.00	1 - Occupation Specific
Varies	**CDL License as required**	0.00	1 - Occupation Specific

50-413-711 Safety, Hazard Awareness, DC Electrical Theory & Orientation to the Trade

Course Outcome Summary

Course Information

Alternate Title	Electric Utility Lineworker Apprenticeship Related Instruction Term 1 (Year 1)
Description	This course is designed to orient apprentices to the basics of electric power distribution systems and the work processes performed by line workers. Course competencies include basic DC electrical theory and their applications. Safety requirements and safe work practices will be taught and reinforced during hands-on learning activities at the school. Students will learn to identify job site hazards. The DC electrical theory unit will explore wire sizing, grounding, and basic meter use. Climbing techniques and safety are included in semester 1 along with arc flash prevention, fall protection, and work positioning equipment safety. Course provides two weeks of related instruction in a block scheduling format.
Career Cluster	Agriculture, Food and Natural Resources
Instructional Level	Technical Diploma
Total Credits	2.25
Total Hours	80.00

Types of Instruction

Instruction Type	Credits/Hours
Classroom presentation, demonstration, discussion and small group learning.	40 hours
School shop/lab/training center with hands-on learning.	40 hours

Target Population

Registered apprentices from electrical line trades and utilities.

Prerequisites

Prerequisite Registered apprentice.

Course Competencies

1. Explore an orientation to the trade

Learning Objectives

1.a. Describe job briefings and provide examples of how they benefit apprentices in electric utilities.
1.b. Define terms, concepts and symbols used by the trade.
1.c. Explain phase identification.

1.d. Describe system voltages.
1.e. Summarize the customer base and regions served by your employer.
1.f. Define your company's role in the community or region.
1.g. Explain how electric rates are determined and who controls rates in your area.
1.h. Match tools and equipment used by the trade with their intended function.
1.i. Explain how contact with electrical lines/devices and electric current flow can injure or kill.
1.j. Describe what is involved in setting up work zone safety zones.

2. Determine personal protective equipment requirements for utility line workers

Learning Objectives

2.a. Outline the rules and regulations found in OSHA 1910.269.
2.b. Identify personal protective equipment requirements for various work processes.
2.c. Describe clothing requirements for job sites.
2.d. Identify fall protection safety requirements and equipment.
2.e. List rubber related PPE available to line workers and match each to its intended purpose.
2.f. Inspect and maintain rubber PPE according to manufacturer's specifications.
2.g. Demonstrate skills inspecting personal protective equipment.
2.h. Demonstrate skills using rubber PPE.
2.i. Sequence the chain of events that led up to an accident.
2.j. Identify safety strategies for hot-line work.
2.k. Describe safe techniques for working on a hot secondary
2.l. Explain rubber glove safety and work practices.
2.m. List rubber gloving hazards.

3. Demonstrate fall protection & work positioning equipment safety

Learning Objectives

3.a. Compare fall protection equipment and devices required for working on overhead horizontal structures.
3.b. Inspect fall protection equipment and devices.
3.c. Compare work positioning techniques required for tasks involving vertical work processes.
3.d. Explain OSHA requirements for various situations and job tasks.
3.e. Demonstrate skills using fall protection equipment.
3.f. Demonstrate the proper care of personal climbing equipment.
3.g. Demonstrate skills related to safe work positioning.

4. Explore environmental and job site hazards

Learning Objectives

4.a. Identify potential environmental hazards.
4.b. Describe safety precautions.
4.c. Explain methods to avoid or re-mediate hazards.
4.d. List insect hazards.
4.e. Classify jobsite environmental hazards.
4.f. Outline steps to deal with working in hot and cold conditions.
4.g. Identify overhead and underground environmental hazards.

5. Compare conductors and cables

Learning Objectives

5.a. Examine OSHA safety and State requirements pertaining to sizing wires and connectors.
5.b. Calculate wire sizes for single service.
5.c. Explain how wire size influences conductivity, resistance, and voltage.
5.d. Compare electrical connector specifications.
5.e. Match electrical connectors to various job site requirements and applications.
5.f. Interpret electrical schematics, drawings, and technical specifications.
5.g. Build skills making secondary connections.
5.h. Describe troubleshooting approaches related to wire and conductors.
5.i. Summarize electrical properties of conductors.
5.j. Compare types and advantages of various overhead conductors.
5.k. Describe work practices associated with overhead conductors, including splices and connections.

6. Apply selected DC electrical theory to power distribution scenarios

Learning Objectives

6.a. Describe the basic concepts involved with conductivity.
6.b. Define resistance and apply key concepts to the powerline, and electrical devices and systems.
6.c. Summarize electrical grounding principles and their relationship to distribution and transmission.
6.d. Explain secondary voltage drops in utility applications.
6.e. Compare series circuits, parallel circuits and combination circuits.
6.f. Identify three-wire secondary applications and related equipment.
6.g. Describe open neutral theory effects and calculations.
6.h. Explain phase identification and how it relates to work performed by the trade.
6.i. Review basic math skills for electrical applications.
6.j. Identify magnetic flux fields.
6.k. Calculate different values of ohms, volts, and amps expected in various electrical circuits.
6.l. Assemble simple circuits and measure values.
6.m. Summarize how Ohm's law is calculated to solve various electrical problems.
6.n. Break down the difference of a series or parallel circuit characteristics.
6.o. Discover flux line and its fields.

7. Demonstrate aerial rescue skills involving pole top and bucket truck simulations

Learning Objectives

7.a. Identify safety equipment involved in aerial rescues.
7.b. Compare company safety procedures related to aerial rescue.
7.c. Explain aerial rescue procedures for pole top emergencies.
7.d. Summarize procedures for aerial rescue operations involving the use of bucket trucks.
7.e. Describe roles and responsibilities for workers, crew members, and emergency response personnel.
7.f. Describe first aid and emergency response procedures immediately following a rescue.
7.g. Build skills and demonstrate proficiency in aerial rescue involving a bucket truck.
7.h. Build skills and demonstrate proficiency in pole top rescue simulations.

8. Demonstrate truck related safe work practices including digger derrick and bucket trucks

Learning Objectives

8.a. Describe digger derrick truck safety requirements.
8.b. Summarize bucket truck safety requirements.
8.c. Explain job site hazard awareness and assessment.
8.d. Relate equipment controls and operations to job site safety.
8.e. Describe communication requirements for given operations.
8.f. Conduct truck pre-flight inspections.
8.g. Perform safe bucket truck set-up operations.
8.h. Perform safe digger truck operations.
8.i. Apply proper rigging procedures.
8.j. Compare synthetic web slings to wire rope slings.
8.k. Interpret manufacturer's rating tags on slings.
8.l. Inspect the different types of slings for defects.
8.m. Analyze sling angles for a proper pick.

9. Establish work zone safety procedures for a variety of job sites

Learning Objectives

9.a. Name work zone safety requirements for truck operations.
9.b. Outline work zone safety requirements when working on or near traffic.
9.c. Describe work zone safety requirements when working overhead (aerial situations).
9.d. List work zone safety requirements for underground construction.
9.e. List work zone safety requirements for overhead construction.
9.f. Outline work zone safety requirements for pole change-outs.
9.g. Summarize work zone safety requirements for line clearance and tree trimming.
9.h. List work zone safety requirements for power outage service calls.
9.i. List work zone safety requirements when responding to storm damage.

10. Rig loads for safe line work

Learning Objectives

10.a. Compare natural fiber and synthetic ropes.
10.b. Inspect rope conditions for wear, damage, contamination and age.
10.c. Explain the care of ropes.
10.d. Identify when and how various rigging knots are used.
10.e. Match knots for their intended use.
10.f. Compare the advantages and disadvantages of each knot.
10.g. Build skills tying knots.
10.h. Evaluate the quality of rigging knots.
10.i. Splice ropes.
10.j. Compare rigging hardware and components.
10.k. Compare rope construction and applications.
10.l. Identify the limitations of rigging equipment and hardware.
10.m. Estimate load weights.
10.n. Compute load forces.
10.o. Build rigging skills using various knots.
10.p. Build skills rigging loads safely.
10.q. Estimate loads
10.r. Describe the role and function of rigging in powerline work.
10.s. Calculate working load limits.
10.t. Demonstrate using ropes and rigging hardware.
10.u. Tie common knots used in line work.
10.v. Identify the appropriate knots to be used in given situations.
10.w. Compare using wire rope to fiber rope.
10.x. Compare types of wire rope terminations.
10.y. Identify specific hazards associated with wire rope.
10.z. Explain when, where, and how to use chains.
10.aa. Illustrate when, where and how to use blocks.
10.bb. Describe the options available to line workers for lifting various load in given situations.
10.cc. Summarize the requirements for working with tensioned conductors.

11. Compare protective grounding fundamentals for distribution line safety

Learning Objectives

11.a. Compare company grounding procedures for line work.
11.b. Summarize company hold card and caution card policies.
11.c. Relate safety manuals to various job site situations.
11.d. Describe hold carding.
11.e. Identify personal protective grounding requirements.
11.f. Use line test equipment properly.
11.g. Perform pole change out with grounded lines and hold carding.
11.h. Differentiate between "old" protective grounding practices and OSHA's required equal potential grounding procedures.
11.i. Identify when protective grounds are required.
11.j. Explain the effectiveness of equal-potential grounding practices.
11.k. Install protective grounds in appropriate locations.
11.l. Remove protective grounds when appropriate.
11.m. Perform installation and removal of protective grounds in a safe manner.
11.n. Identify grounding to the power grid.
11.o. Review overhead grounding practices.
11.p. Summarize bracket grounding practices.
11.q. Explain the reasons for installing protective grounds.
11.r. Describe methods for applying the grounding principle to control current.
11.s. Explain methods for applying the bonding principle to control voltage.
11.t. Summarize methods for controlling induced voltage and current.
11.u. Compare the procedures and requirements for applying protective grounds.
11.v. Identify specific hazards associated with grounding.
11.w. Summarize the application of protective grounding to underground cable systems.

12. Perform line clearance and tree trimming

Learning Objectives

12.a. Describe line clearance requirements.
12.b. Explain the concepts associated with integrated vegetation management.
12.c. Compare tree trimming techniques used by the trade.
12.d. Demonstrate skills limbing brush.
12.e. Demonstrate skills cutting logs.
12.f. Demonstrate skills cutting stumps.
12.g. Describe how to make open-face notches and why.
12.h. Describe how hinges work.
12.i. Describe the role and function of vegetation management In electrical utilities.
12.j. Explain the elements of a utility integrated vegetation management.
12.k. Identify and compare quality pruning methods.
12.l. Identify tree related hazards and risks.
12.m. Summarize tree work processes near electrical circuits.
12.n. Describe the steps involved with conducting a treetop rescue.
12.o. Build essential skills for tree work performed by line workers.

13. Operate chainsaws

Learning Objectives

13.a. List personal protective equipment required for chain saw operations.
13.b. Identify the reactive forces of a chainsaw.
13.c. Inspect chainsaws to assure safety features are present and functional.
13.d. Demonstrate proper starting techniques.
13.e. Demonstrate proper hand placement during operations.
13.f. Demonstrate proper body positioning during operations.
13.g. Demonstrate proper use of chain brakes.
13.h. Describe maintenance requirements for chain saws.
13.i. Explain chain sharpening techniques.
13.j. Operate chains saws according to industry safety standards.

14. Demonstrate skills using meters and testing circuits

Learning Objectives

14.a. Describe safety and PPE requirements for testing electrical lines, devices and equipment.
14.b. Compare types of meters and testers used by the trade.
14.c. Match types of meters to various line voltages.
14.d. Measure values of ohms.
14.e. Determine values for volts.
14.f. Test for and record amps.
14.g. Test for continuity.

15. Explore arc flash hazards associated with utility lines and equipment

Learning Objectives

15.a. Describe methods to prevent arc flash.
15.b. Identify safety and PPE requirements related to arc flash.
15.c. Build skills using fire extinguishers for arc flash emergencies.
15.d. Colleges and local committees may determine additional or alternative learning objectives as needed to meet local needs.
15.e. Instructors will align learning objectives with selected assessment strategies and criteria based on local resources.
15.f. Learning activities will include instructor developed PowerPoint presentations and other learning materials.
15.g. This competency may be incorporated into other competencies during phase 2.

16. Examine the damaging effects of arc flash in a work setting

Learning Objectives

16.a. Explain the causes of an arc flash.
16.b. Describe clothing ratings, requirements, and safety issues.
16.c. Compare natural fiber, synthetics, and flame retardant clothing in an arc flash.
16.d. Compare heating effects on natural fiber, synthetics, and flame retardant clothing.

16.e. Describe basic rules to meet OSHA regulations and company safety manuals.
16.f. Explain the effect of arc flash on equipment and property.
16.g. Sequence the chain of events that leads up to an arc flash accident.

17. Climb poles using industry accepted procedures & safe work practices

Learning Objectives

17.a. Review safety manual information related to climbing.
17.b. Match climbing equipment and tools to their role and function.
17.c. Explain proper sizing techniques.
17.d. Build skills inspecting climbing equipment.
17.e. Build skills inspecting personal safety equipment.
17.f. Demonstrate care of personal climbing equipment.
17.g. Demonstrate basic climbing techniques.
17.h. Demonstrate proper sharpening techniques for climbers/gaff.
17.i. Build basic climbing skills on a pole.
17.j. Develop confidence working at heights.

50-413-712 Electrical Theory 2, Codes & Overhead Construction

Course Outcome Summary

Course Information

Alternate Title	Electric Utility Lineworker Apprenticeship Related Instruction Term 2 (Year 1)
Description	Course examines the National Electric Safety Codes & Wisconsin PSC rules and regulations. In addition, competencies related to solving electrical problems, parallel and series circuits, power factors, circuit protection, metering, grounding, power quality and renewable energy are included. Apprentices will also build skills with using meters and test equipment. Apprentices will build skills applying OSHA 1910.269 and other safety requirements to troubleshooting equipment and components. Course provides two weeks of related instruction in a block scheduling format.
Career Cluster	Agriculture, Food and Natural Resources
Instructional Level	Technical Diploma
Total Credits	2.25
Total Hours	80.00

Types of Instruction

Instruction Type	Credits/Hours
Classroom presentation, demonstration, discussion and small group learning.	40 hours
School shop/lab/training center with hands-on learning.	40 hours

Purpose/Goals

Course provides related instruction for first year apprentices.

Target Population

Registered apprentices from electrical line trades and utilities.

Prerequisites

Prerequisite 50-413-711 is a suggested pre-requisite.

Course Competencies

1. Solve electrical problems using Ohm's Law and basic trade math

Learning Objectives

1.a. Add, subtract, multiply and divide whole numbers and fractions.
1.b. Solve algebraic problems.
1.c. Compute power and energy values using formulas.

1.d. Solve spatial problems with geometry.
1.e. Calculate voltage drops.
1.f. Solve triangle related problems using trigonometry.
1.g. Identify magnetic flux fields.
1.h. Apply electrical terms and definitions to electrical power distribution field.
1.i. Describe parts of the atom.
1.j. Measure different values of ohms, volts, and amps.
1.k. Assemble simple circuits and measure values.
1.l. Summarize how Ohm's is calculated.
1.m. Break down the difference of a series or parallel circuit characteristics.
1.n. Discover flux line and its fields.

2. Analyze series and parallel circuits

Learning Objectives

2.a. Identify R-L series circuits.
2.b. Explain the purpose of R-L series circuit analysis.
2.c. Define impedance as it relates to R-L series circuits.
2.d. Perform vector analysis.
2.e. Perform circuit calculations.
2.f. Identify phase angles.
2.g. Identify the power factor.
2.h. Identify R-C series circuits.
2.i. Explain the purpose of R-C series circuit analysis.
2.j. Define impedance as it relates to R-C series circuits.
2.k. Perform vector analysis.
2.l. Perform circuit calculations.
2.m. Identify phase angles.
2.n. Identify the power factor.
2.o. Identify R-L and R-C parallel circuits.
2.p. Explain phase relationships.
2.q. Perform circuit calculations.
2.r. Identify vector representations.
2.s. Explain frequency response.
2.t. Identify the power factor.
2.u. Review R-L-C series circuit analysis.
2.v. Review R-L-C parallel circuit analysis.
2.w. Explain series resonance.
2.x. Identify parallel resonant circuits.
2.y. Describe power factor correction.

3. Calculate power factors

Learning Objectives

3.a. Define terms related to power factors.
3.b. Describe applications for calculating power factor conversions.
3.c. Computer power factors for various situations.
3.d. Relate power factor corrections to electrical circuits.
3.e. Relate power factor corrections to capacitors.

4. Explore circuit and system protection strategies used by utilities

Learning Objectives

4.a. Explain the role and function of system protection for circuits and devices.
4.b. Summarize procedures used by the trade to monitor protection.
4.c. Describe the role and functions of customer grounds to the electric systems.
4.d. Define what is meant by the power grid.

5. Compare Watt-hour mechanical metering systems to digital metering systems

Learning Objectives

5.a. Explain the purpose of watt-hour meters in a power distribution system.

5.b. Describe the operation of a watt-hour meter.
5.c. Interpret nameplate information found on meters.
5.d. Identify the layout of a clock type meter face.
5.e. Determine the reading for a clock type meter.
5.f. Demonstrate clock type reading procedures.
5.g. Proofread the clock type reading for correctness.
5.h. Summarize the shift from mechanical kilowatt hour meters to electronic kilowatt hour meters in terms of benefits to customers and utilities.
5.i. Contrast clock type meter readings to digital meters readouts.
5.j. List the proper sequence of steps required for meter installation and removal procedures.
5.k. Describe effective customer service skills related to metering.
5.l. Examine safe work practices related to installing and maintaining meters.

6. Examine system and customer grounding techniques

Learning Objectives

6.a. Explain the purpose of transmission system circuit protection.
6.b. Describe the role and function of relays.
6.c. Summarize the role and function of circuit breakers.
6.d. List the requirements for distribution protection.
6.e. Explain overcurrent protection.
6.f. Describe protection for distribution feeders.
6.g. Summarize the role and function of reclosers.
6.h. Explain overvoltage protection techniques and applications.
6.i. Describe the role and function of surge arrestors.
6.j. Summarize the requirements for system grounding protective devices.
6.k. Compare troubleshooting techniques for system grounding.

7. Communicate green/renewable energy trends, equipment and technologies

Learning Objectives

7.a. Explain how alternative energy impacts electric rate structures.
7.b. Describe time of use rates.
7.c. Use power curves to help explain load shaping, load building, load shedding, and load shifting.
7.d. Explain why governmental support for renewable distributed generation (RDG) is increasing.
7.e. Examine current construction costs for new base load generation.
7.f. Describe the differences between peaking generation and base load generation.
7.g. Compare utility/contractor/employer specific requirements that pertain to RDG.
7.h. Describe solar array installations.
7.i. Describe wind farms and collector systems.
7.j. Summarize physical connections, interconnects and disconnects used in RDG.
7.k. Describe isolating switches and the intent of isolation.
7.l. Identify correct wiring and proper connections.
7.m. Identify distributed generation interconnections, distribution, and transmission.
7.n. List the advantages and disadvantages of RDG technologies.
7.o. Identify the specific system requirements for selected RDG.
7.p. Describe the advantages and disadvantages of RDG systems to customers and utilities.

8. Examine the overall structure of the NESC electrical codes and State rules & regulations

Learning Objectives

8.a. Summarize the purpose, scope, and application of the electrical codes included in the introduction to the NESC.
8.b. Paraphrase the definitions and special terms referenced in the NESC handbook.
8.c. Explain how the references section of the NESC can aid lineworkers.
8.d. Describe the grounding methods for electric supply and communication facilities contained in the NESC handbook.
8.e. Apply OSHA 1910.269 and other OSHA rules and regulations to the job duties and tasks performed by line workers.
8.f. Recognize the role of the Public Service Commission.
8.g. Compare the State of Wisconsin rules and regulations to employer guidelines for the workplace.
8.h. Differentiate the National Electric Safety Code and Wisconsin Administrative Code.

8.i. Explain rule numbers within the codes.
8.j. Associate Wisconsin Administrative Code with the NESC.
8.k. Distinguish substation good and bad practice code issues.
8.l. Calculate overhead clearances and conductor and equipment spacing.
8.m. Read clearance charts.
8.n. Identify code violations using various scenarios.
8.o. Summarize how PSC 119 supports renewable distributed generation (RDG) and lineworkers.
8.p. Determine overhead equipment ground clearances.
8.q. Reference a rule within the codes.
8.r. Explain a rule within the codes.
8.s. Locate distributed generation rules, codes, and standards.
8.t. Layout a scenario concerning overhead and underground clearance.

9. Summarize the rules [electrical codes] for the operation of electric supply and communications lines and equipment (NESC part 4)

Learning Objectives

9.a. Describe the purpose and scope of rules pertaining to the operation of electric supply and communication lines and equipment.
9.b. Compare the rules for employers pertaining to supply and communication systems as called for in the NESC.
9.c. Identify the general rules for employees.
9.d. Identify the additional rules for communications employees.
9.e. Explain the additional rules for supply employees.

10. Interpret maps and electrical symbols & schematics used by utilities

Learning Objectives

10.a. Define terms and concepts.
10.b. Describe the technical specifications contained in utility maps.
10.c. Label symbols and schematics related to various electrical scenarios.
10.d. Relate non-technical map information to work orders and job sites.
10.e. Assemble a staking sheet using proper schematic symbols.
10.f. Interpret a staking sheet from another crew.
10.g. Incorporate the NESC and Wisconsin Administrative Codes to staking sheet plans.

11. Relate the importance of conductor properties to power quality

Learning Objectives

11.a. Explain the importance of conductor properties and how they related to power quality.
11.b. Differentiate between copper and aluminum conductivity.
11.c. Identify the properties of copper and aluminum.
11.d. Distinguish between solid, stranded, and bus bar conductor properties.
11.e. Identify different sizes and types of construction found in conductors.
11.f. Calculate the difference between circular mils and square mils.
11.g. Compare the conductivity of steel, copperweld copper, aluminum, ASCR and other types of line construction conductors.
11.h. Compare specific resistance "K" values of conductors.
11.i. Analyze voltage drop for different conductors.
11.j. Calculate ohms per foot.
11.k. Contrast the conductivity of small versus large conductors and their materials.
11.l. Calculate voltage drop at single phase 3 wire secondary services.

12. Apply 3 wire service fundamentals to problem-solving and trouble-shooting

Learning Objectives

12.a. Explain three wire service fundamentals.
12.b. Differentiate between service requirements for copper and aluminum conductors.
12.c. Identify the properties of copper and aluminum as they relate to problem solving and troubleshooting.
12.d. Relate different sizes and types of construction found in conductors to problem solving.
12.e. Compare the conductivity of steel, copperweld copper, aluminum, ASCR and other types of line construction conductors to troubleshooting systems and devices.

12.f. Test for and measure specific resistance "K" values of conductors.
12.g. Analyze voltage drop for different conductors.
12.h. Contrast the conductivity of small versus large conductors and their materials.
12.i. Discover the importance of a closed neutral in a 3 wire single phase service.
12.j. Differentiate the power quality characteristics of a closed neutral versus an open neutral scenario.
12.k. Identify the electrical characteristics of an open neutral.
12.l. Interpret voltage readings in an open neutral setting.
12.m. Demonstrate the testing procedures of an open neutral setting.

13. Compare overhead construction techniques used by utilities

Learning Objectives

13.a. Summarize safe work practices to follow during overhead construction.
13.b. Interpret overhead construction drawings, schematics, diagrams and technical specifications.
13.c. Examine specialized tools, equipment and devices required for overhead construction.
13.d. Associate NESC, PSC, and OSHA 1910.269 requirements for overhead construction.
13.e. Classify overhead power systems by operating voltages.
13.f. Compare towers & structures used by utilities.
13.g. Identify conductor types, sizes, construction and applications.
13.h. Compare and contrast power pole features and functions.
13.i. Identify insulators and insulation techniques.
13.j. List the materials of construction used including wood, steel, concrete, reinforced plastics and composites.
13.k. Describe four types of circuits used in transmission.
13.l. Clarify ground conductors and their role and function.
13.m. Match compact transmission lines to their applications and unique construction requirements.
13.n. Match low voltage overhead lines to their application and unique construction requirements.
13.o. Report on specialized construction practices required when spanning water, crossing right-of-ways, working in mountainous regions, and addressing other geo-physical or unique challenges.

14. Demonstrate skills required for overhead single phase transformer connections and installations

Learning Objectives

14.a. Apply basic electrical principles to single phase.
14.b. Describe the roles and functions of pole top equipment and transformers.
14.c. List the applicable safety and PPE requirements.
14.d. Name the specialized tools and equipment required for working on pole top equipment and transformers.
14.e. Interpret single phase transformer technical specification and related work orders.
14.f. Compare single phase transformer connections used by the trade.
14.g. Summarize the steps required to install single phase transformers.
14.h. Describe the procedures involved in servicing pole top equipment and transformers.

15. Explain solutions to stray voltage problems

Learning Objectives

15.a. Describe how stray voltage impacts customers and the utilities.
15.b. Explain how stray voltage occurs and give examples of common scenarios when it occurs.
15.c. Demonstrate how to test for stray voltage.
15.d. List remedies for common stray voltage problems.
15.e. Identify the cost-benefits involved in each remedy for fixing stray voltage problems.
15.f. Build skills communicating stray voltage related information to customers and the public.

16. Examine various overhead utility and power transmission/distribution applications

Learning Objectives

16.a. Observe utility applications in the field.
16.b. Note work processes which involve skilled workers from the trade.
16.c. List job duties and tasks associated with installing, maintaining, and servicing equipment.
16.d. Obtain information from sites visited and personnel interviewed.
16.e. Relate observations to competencies taught in the apprenticeship.
16.f. Note how concepts and principles discussed in class are put into service.

16.g. Complete field trip checklist/report provided by the instructor.

17. Apply overhead construction troubleshooting skills to solve problems

Learning Objectives

17.a. Identify common problems associated with overhead construction.
17.b. Examine methods to inspect, test, and verify faults associated with overhead circuits.
17.c. Identify troubleshooting processes used by utilities.
17.d. List the steps involved in troubleshooting.
17.e. Examine how workers approach problem solving in electric utilities.
17.f. Apply each of the following terms to the troubleshooting process: Analyze, Check, Define, Describe, Differentiate, Explain, Illustrate, Maintain, Overhaul, Repair, Service, and Troubleshoot.
17.g. Identify the resources needed for troubleshooting and problem solving.
17.h. List the key steps involved with inspecting, servicing, repairing, and troubleshooting equipment systems and components.
17.i. Identify safety related issues and procedures for working with electrical and mechanical systems and components.
17.j. Participate in a review of first year competencies and learning objectives.

50-413-713 AC Electrical Theory, Generation and Distribution Fundamentals, Voltage Regulation and Power Quality

Course Outcome Summary

Course Information

Alternate Title	Electric Utility Lineworker Apprenticeship Related Instruction Term 3 (Year 2)
Description	Course competencies and learning objectives include an introduction to AC electrical theory and its applications; an examination of Ohm's Law and related principles; concepts pertaining to generation & distribution of AC energy; inductors and electric apparatus & equipment. A review of 1st Year and OSHA 1910.269 safety requirements are included. Course provides two weeks of related instruction in a block scheduling format.
Career Cluster	Agriculture, Food and Natural Resources
Instructional Level	Technical Diploma
Total Credits	2.25
Total Hours	80.00

Types of Instruction

Instruction Type	Credits/Hours
Classroom presentation, demonstration, discussion and small group learning.	40 hours
School shop/lab/training center with hands-on learning.	40 hours

Purpose/Goals

Course provides related instruction for second year apprentices.

Target Population

This program is designed for students seeking employment as electrical line workers or electrical line worker apprentices.

Prerequisites

Prerequisite 50-413-712 and/or successful completion of first year is suggested.

Course Competencies

1. Examine electric system generation, transmission, distribution, and grounding

Learning Objectives

1.a. Explain power generation and its role in the electric system.
1.b. Describe power transmission and its role in the electric system.
1.c. Summarize power distribution and its role in the electric system.
1.d. Define the role and function of circuit and system protection in electric utilities.
1.e. Explain customer grounding equipment, devices, and requirements.

1.f. Explain how electric systems are monitored and controlled.
1.g. Explain how renewable energy generation is changing the electric system.
1.h. Relate the job duties and tasks performed by lineworkers to generation, transmission, distribution and distributed renewable generation.

2. Operate Volt-Ohm meters and digital multimeters on AC circuits

Learning Objectives

2.a. Discuss the internal operation of meter movements.
2.b. Connect a volt meter in a circuit.
2.c. Connect an analog multimeter.
2.d. Read an analog multimeter.
2.e. Measure resistance with an ohm meter.
2.f. Measure electrical quantities.
2.g. Analyze electrical circuits.
2.h. Interpret meter readings, scales, and symbols.

3. Use electrical testing equipment on AC circuits

Learning Objectives

3.a. Apply hand-held multi-meters to low voltage tests and situations.
3.b. Explain voltage readings for various tests and circuits.
3.c. Build skills using a phase rotation tester for trade work practices.
3.d. Build skills using a clamp-on ammeter for various applications.
3.e. Build skills using a high voltage tester for given specifications.
3.f. Build skills using phasing sticks on primary circuits.

4. Explore AC generation and power quality principles

Learning Objectives

4.a. Describe sine wave.
4.b. Explain induction.
4.c. Compare inductive circuits.
4.d. Relate resistance to electrical systems and components.
4.e. Compare resistance/inductive circuits.
4.f. Describe power factors.
4.g. Explain phase angles.
4.h. Review related electrical principles and their influence on AC generation.

5. Examine principles of AC electrical theory for transmission and distribution

Learning Objectives

5.a. Describe capacitors used by utilities.
5.b. Explain capacitance and its relationship to power generation, transmission, distribution and end use.
5.c. Calculate power factor corrections.
5.d. Compare capacitor connections.
5.e. Summarize capacitor switching procedures.
5.f. Compare resistance/capacitance circuits.
5.g. Compare resistance/inductance/capacitive circuits.

6. Relate basic AC electrical theory to trade practices

Learning Objectives

6.a. Identify magnetic flux fields.
6.b. Apply electrical terms and definitions to electrical power distribution field.
6.c. Describe parts of the atom.
6.d. Demonstrate the different types of meters.
6.e. Measure different values of ohms, volts, and amps.
6.f. Assemble simple circuits and measure values.
6.g. Summarize how Ohm's is calculated for various applications.
6.h. Break down the difference of a series or parallel circuit characteristics.
6.i. Discover flux line and its fields.

7. Interpret AC fundamentals for electrical circuits found in the power industry

Learning Objectives

7.a. Explore and compare the difference of generation processes, transmission systems, and distribution characteristics.
7.b. Define RMS.
7.c. Define Peak and Peak-to-Peak.
7.d. Break down the Pythagorean Theorem.
7.e. Calculate degrees of angle.
7.f. Identify a leading or lagging current circuit.
7.g. Draw a vector with values.
7.h. Identify magnetic flux fields.
7.i. Describe the difference between power and energy and how it is used.
7.j. Explain renewable distributed generation.
7.k. Discuss the different types of renewable RDG systems.
7.l. Summarize the operation of RDG system equipment.
7.m. Identify the key RDG system components.
7.n. Summarize the impact of RDG to the electric grid, utility, and trade.
7.o. Describe the differences between parallel and non-parallel generator operations.
7.p. Compare the type of RDG equipment typically found in various systems.
7.q. Describe the inter-relationships between equipment commonly found in RDG system.
7.r. Report on the advantages and disadvantages of RDG systems to customers and utilities.

8. Examine the parts and operations of power capacitors and installations

Learning Objectives

8.a. Identify parts of a power capacitor.
8.b. Identify operation of a power capacitor.
8.c. Outline the steps and work involved with installation of power capacitors.
8.d. Describe maintenance, service and repair of power capacitors.
8.e. Interpret technical information and equipment specifications for power capacitors.
8.f. Describe how to troubleshoot systems and equipment.

9. Calculate values for various types of AC circuits

Learning Objectives

9.a. Calculate series resistive inductive circuits.
9.b. Calculate series resistive capacitive circuits.
9.c. Calculate parallel resistive inductive circuits.
9.d. Calculate parallel resistive capacitive circuits.
9.e. Calculate amount of capacitance needed for resonance circuits.

10. Examine principles involved with inductors

Learning Objectives

10.a. Describe the nature of inductance.
10.b. Identify the physical factors affecting inductance.
10.c. Identify the types of inductors.
10.d. Explain total inductance of series and parallel connections.
10.e. Define the term inductive reactance.
10.f. Explain the effects of inductive reactance on phase relationship.
10.g. Relate inductor principles to equipment, systems and power.

11. Apply voltage regulation fundamentals to work performed by the trade

Learning Objectives

11.a. Define power quality and list ways it can be interrupted.
11.b. Explain the key factors affecting voltage in a circuit.
11.c. Compare concepts pertaining to voltage control and voltage regulation.
11.d. Apply voltage control principles to transmission lines.
11.e. Apply control principles to substation distribution voltages.
11.f. Relate voltage regulation principles to distribution feeder voltages.
11.g. Outline troubleshooting responses for voltage regulators faults.
11.h. Summarize the role and function of capacitors in power quality and voltage regulation.

11.i. Examine the line workers role with troubleshooting no power, high voltage and low voltage situations.

12. Investigate overcurrent protection strategies used by utilities

Learning Objectives

12.a. Describe the role and function of circuit breakers and protective switchgears.
12.b. Explain the operation and use of reclosers in distribution systems.
12.c. Compare types of reclosers used in various situations.
12.d. Summarize the operation of sectionalizers.
12.e. Explain the operation of distribution cutouts.
12.f. Compare the role, function, and operation of fuses.
12.g. Identify overcurrent protective devices installed in the field.
12.h. Identify PPE and safety requirements when installing and servicing protective devices.
12.i. Outline troubleshooting strategies for working with faulty devices.
12.j. Describe the role and function of capacitor banks in overcurrent protection and power quality.

13. Demonstrate safe meter installation and service

Learning Objectives

13.a. Explain metering basic concepts, terms, and types.
13.b. Identify safety and PPE requirements for working with meters.
13.c. Match tools and equipment used by the trade with their intended use.
13.d. Demonstrate meter and test equipment use and applications.
13.e. Build skills installing meters.
13.f. Build skills servicing meters.
13.g. Apply effective customer service skills related to meter work.
13.h. Describe the role and function of meters in electrical systems.
13.i. Determine the types of charges to customers.
13.j. Compare and contrast electromechanical and electronic meters.
13.k. Explain how the various types of power are measured.
13.l. Summarize single phase metering and the implications for line workers.
13.m. Describe polyphase metering and the impact it has on line workers and customers.
13.n. Explain transformer-rated metering applications.
13.o. Identify PPE and safety requirements associated with Watt-Hour metering work.
13.p. Outline troubleshooting strategies for servicing faulty devices.
13.q. Build skills using test equipment associated with metering.

14. Summarize the rules [electrical codes] for the installation and maintenance of electric supply stations and equipment (NESC part 1).

Learning Objectives

14.a. Describe the purpose and scope of rules pertaining to electric supply stations and equipment.
14.b. Compare protective arrangements as called for in the NESC.
14.c. Identify the requirements for installation of equipment and devices.
14.d. Identify the requirements for maintenance of equipment and devices.
14.e. Explain the code requirements for rotating equipment.
14.f. Summarize the code requirements for storage batteries.
14.g. Describe the code requirements for transformers and regulators.
14.h. Explain the code requirements for conductors.
14.i. Compare the code requirements for circuit breakers, reclosers, switches and fuses.
14.j. Summarize the code requirements for switchgears and metal enclosed bus.
14.k. Describe the code requirements for surge arrestors.

50-413-714 Underground Distribution Systems & Electrical Codes
Course Outcome Summary

Course Information

Alternate Title	Electric Utility Lineworker Apprenticeship Related Instruction Term 4 (Year 2)
Description	Course competencies and learning objectives examine the Wisconsin Administrative Codes and PSC rules and regulations, equal-potential grounding, handling energized and de-energized cables and troubleshooting open neutral problems. Apprentices will explore lightning arrestors, smart grid technologies, and street light maintenance and installation. Underground distribution related competencies will focus on schematics, cable locating, fault detection, insulated cables, grounding practices, construction techniques, and maintenance. Applicable OSHA 1910.269 requirements and PSC rules and regulations are reviewed. Course provides two weeks of related instruction in a block scheduling format.
Career Cluster	Agriculture, Food and Natural Resources
Instructional Level	Technical Diploma
Total Credits	2.25
Total Hours	80.00

Types of Instruction

Instruction Type	Credits/Hours
Classroom presentation, demonstration, discussion and small group learning.	40 hours
School shop/lab/training center with hands-on learning.	40 hours

Purpose/Goals

Course provides related instruction for second year apprentices.

Target Population

This program is designed for students seeking employment as electrical line workers or electrical line worker apprentices.

Prerequisites

Prerequisite 50-413-713 is a suggested prerequisite.

Course Competencies

1. Examine Wisconsin Administrative Codes and utility safe work practices

Learning Objectives

1.a. Explain how to locate Wisconsin Public Service Commission rules and regulations.
1.b. Describe the purpose and contents found in PSC 113

1.c. Summarize how PSC 114 provides rules and regulations for utilities & line workers.
1.d. Explain how PSC 119 serves as a resource for line workers.
1.e. Summarize how the various code sections articulate with each other.
1.f. Relate PSC rules and regulations to NEC, NESC, and other electrical codes.

2. Summarize the rules [electrical codes] for the installation and maintenance of underground electric supply and communication lines (NESC part 3).

Learning Objectives

2.a. Describe the purpose, scope and application of rules pertaining to the installation and maintenance of underground electric supply and communication lines.
2.b. Compare the general NESC rules applying to underground lines.
2.c. Identify the requirements for underground conduit systems.
2.d. Identify the requirements for supply cables.
2.e. Explain the code requirements for cable in underground structures.
2.f. Summarize the code requirements for direct buried cables.
2.g. Describe the code requirements for risers.
2.h. Explain the code requirements for supply cable terminations.
2.i. Compare the code requirements for underground equipment.
2.j. Summarize the code requirements for installations in tunnels.
2.k. Relate NESC electrical codes to job duties and tasks associated with the trade.

3. Apply basic electrical theories and principles to underground distribution systems

Learning Objectives

3.a. Describe important DC electrical theories which pertain to underground distribution.
3.b. Summarize key AC electrical principles which apply to underground distribution.
3.c. Relate key power concepts to Underground Residential Distribution installations and devices.
3.d. Explain grounding as it applies to Underground Residential Distribution.
3.e. Answer the question - 'Why underground distribution lines?'.
3.f. Describe safety requirements for working on underground distribution equipment.
3.g. List the tools and equipment used for underground distribution.
3.h. Describe underground distribution systems used for different situations.
3.i. Explain the role and function of components found in Underground Residential Distribution systems.
3.j. Match Underground Residential Distribution construction techniques to job duties and tasks performed by the trade.
3.k. Demonstrate Underground Residential Distribution construction techniques and skills.
3.l. List common work processes, and tools and equipment, used by workers installing Underground Residential Distribution systems.
3.m. List common work processes used by workers when servicing Underground Residential Distribution.
3.n. Summarize Underground Residential Distribution troubleshooting techniques.
3.o. Describe maintenance tasks associated with underground lines.
3.p. Compare duct and vault systems.
3.q. List civil work involved with underground systems.
3.r. Summarize the work processes involved in pulling and laying cable.
3.s. Explain terminations and splices used for underground systems.
3.t. Identify ferro-resonance and over-voltages.
3.u. Analyze ferro-resonance.

4. Demonstrate proper handling procedures of energized and de-energized underground cables

Learning Objectives

4.a. Describe the PPE requirements and safe work practices when working on or around URD cables.
4.b. Build skills using a shotgun stick
4.c. Build skills using an elbow removal stick (slam stick).
4.d. Demonstrate skills using high voltage meters.
4.e. Summarize the procedures to verify energized cables and de-energized cables.
4.f. Describe the procedures to isolate cables.
4.g. Describe grounding requirements for URD cables.
4.h. Explain the use of other equipment such as feed throughs and stand offs.

5. Troubleshoot open neutral problems associated with underground distribution equipment

Learning Objectives

5.a. Describe the PPE requirements and safe work practices when working on or near open neutral problems.
5.b. Identify tools and equipment used to troubleshooting open neutrals.
5.c. Identify hazards associated with open neutrals.
5.d. Explain how to prevent open neutrals.
5.e. Classify customer concerns related to open neutrals.
5.f. List the causes of open neutrals including equipment, accidents, storms, and customers.
5.g. Compare company troubleshooting protocols for open neutral problems.

6. Interpret maps, schematics and drawings for underground installations

Learning Objectives

6.a. Compare maps and plot drawings.
6.b. Interpret equipment drawings and manufacturer's technical information.
6.c. Define symbols, abbreviations, terms, legends used on trade drawings.
6.d. Compare field sketches, CAD drawings, and paper-based prints.
6.e. Compare to use of line drawings and equipment prints.
6.f. Locate map orientation information (NSEW and geographical bearings).
6.g. Examine system maps used by utilities.
6.h. Compare equipment drawings for various underground applications.
6.i. Sketch a simple line drawing with lines and labels for an underground installation selected by the trade.
6.j. Reflect on how maps and schematics can be one of the tools in the line workers toolbox.
6.k. Apply GPS, laptops/mobile devices, and digital maps to underground field work.

7. Confirm underground cable location and fault detection

Learning Objectives

7.a. Identify the PPE requirements and safe work practices for locating underground cables, equipment and faults.
7.b. Demonstrate the use of fault detection equipment.
7.c. Identify hazards associated with equipment.
7.d. Identify hazards associated with working in the field.
7.e. Compare different types of fault detection equipment.
7.f. Determine equipment maintenance timelines and requirements.
7.g. Demonstrate the use of cable location equipment.
7.h. Verify utility marking requirements.
7.i. Identify different types of faults.
7.j. Describe causes of faults.

8. Examine the construction of underground insulated cables

Learning Objectives

8.a. Role and function of insulated cables in URD.
8.b. Identify parts of primary URD cables.
8.c. Identify parts of secondary URD cables.
8.d. Determine primary vs. secondary lines in different installations.
8.e. Compare types of insulation and cable.
8.f. Compare wire sizes for primary and secondary.
8.g. Relate cable construction to terminations.

9. Layout an underground residential distribution system

Learning Objectives

9.a. Respond to a case study or scenario involving designing a simple URD system.
9.b. Identify equipment requirements for new installations.
9.c. Identify material requirements.
9.d. Create a schematic, sketch, or line drawing with symbols and legend.
9.e. Interpret utility company standards.
9.f. Reference maps, GPS, and system information.
9.g. Show cable lines, equipment and service connection.

10. Demonstrate skills with underground residential distribution cable prep and termination

Learning Objectives

10.a. Answer the question - 'why do you prepare the cables according to mfg. specifications?'
10.b. Interpret manufacturer's specifications.
10.c. Describe the types of tools used in cable prep and termination.
10.d. Demonstrate tool use.
10.e. Build skills using the correct tools for the type of cable.
10.f. Calibrate tools.
10.g. Explain the use of grounding cables before and during prep and termination.
10.h. Measure accurately in accordance with manufacturer specifications.
10.i. Explain the importance of cable cleanliness during prep and termination.

11. Demonstrate skills splicing underground residential distribution cables

Learning Objectives

11.a. Answer the question - 'why do you splice cables according to mfg. specifications'?
11.b. Interpret manufacturer's specifications.
11.c. Describe the types of tools used in splicing cables.
11.d. Demonstrate proper tool use.
11.e. Demonstrate using the correct tools for the type of cable.
11.f. Calibrate tools.
11.g. Describe the use of grounding cables before and during splicing.
11.h. Measure accurately and in accordance with manufacturer's specifications.
11.i. Explain the importance of cable cleanliness during prep and termination.
11.j. Compare splicing of energized and de-energized cables.
11.k. Summarize personal protective grounding techniques and requirements.
11.l. Identify excavation safety associated with splicing.
11.m. Identify splice locations due to a fault.

12. Compare underground grounding practices

Learning Objectives

12.a. Define the terms related to grounding concentrics.
12.b. Compare tank grounds, ground rods, concentrics, and other grounding techniques.
12.c. Identify locations for grounding.
12.d. Explain grounding specifications fond in utility company standards.
12.e. Describe ways for coordinating grounding between main ground and other devices.
12.f. Identify hazards associated with improper grounding.
12.g. Relate underground grounding practices to electrical codes.

13. Analyze underground construction techniques

Learning Objectives

13.a. Describe the work involved in site preparation.
13.b. Explain construction equipment needs and placement for given situations.
13.c. Summarize where and how to install underground cables.
13.d. Describe how to plan an excavation
13.e. Identify safety, potential hazards, and safe work practices for construction zones.
13.f. Install URD equipment and placement of transformers, pedestals, and other components.
13.g. Identify what is to be installed
13.h. Interpret maps used for construction work sites.
13.i. Relate NESC and other company standards to underground construction practices.
13.j. Tag cables and URD equipment devices according to prints and maps.

14. Demonstrate skills with switching single phase and three phase underground distribution

Learning Objectives

14.a. Describe the PPE requirements and safe work practices when working on or around URD cables.
14.b. Build skills using a shotgun stick.
14.c. build skills using an elbow removal stick (slam stick).
14.d. Demonstrate the proper use of high voltage meters.

14.e. Summarize the steps required to verify energized and de-energized cables.
14.f. Compare techniques and procedures for isolating cables.
14.g. Describe grounding requirements.
14.h. Explain the use of other equipment such as feed throughs and stand offs.
14.i. Summarize the procedures to verify single phase and three phase.
14.j. Identify hazards associated with single phase and three phase.

15. Demonstrate skills troubleshooting underground residential distribution

Learning Objectives

15.a. Describe the PPE requirements and safe work practices when working
15.b. Identify tools and equipment used to troubleshooting faults and problems.
15.c. Identify hazards associated with troubleshooting URD.
15.d. Explain how to prevent half powers and no powers.
15.e. Characterize customer concerns resulting from half powers and no powers.
15.f. List the common causes of half powers and no powers including equipment, accidents, storms, customers.
15.g. Compare company troubleshooting protocols.
15.h. Respond to a case study or scenario selected by the instructor pertaining to troubleshooting URD equipment.
15.i. Apply the 7-step troubleshooting process (or other industry accepted procedure) to servicing URD.

16. Apply basic pad mounted transformer and underground cable principles to field installations

Learning Objectives

16.a. Explain the role and function of pad mounted equipment in various distribution systems.
16.b. Describe the safety requirements for working on pad mounted transformers and switchgears.
16.c. Identify pad mounted transformers and switchgears equipment components.
16.d. Explain the installation of pad mounted transformers.
16.e. Describe the maintenance requirements of pad mounted transformers.
16.f. List the sequence of steps involved in installing new and servicing existing pad mounted transformers.
16.g. Summarize troubleshooting techniques for pad mounted transformers.
16.h. Compare the types of underground cables and their application.
16.i. Differentiate transmission, distribution, and secondary cables.
16.j. Identify cable shielding options and alternatives.
16.k. List the causes of cable failure.
16.l. Describe the requirements for cable splicing and terminations.
16.m. Apply ampacity, voltage, and current to underground cabling.
16.n. Describe the role and function of bayonet fuses.

17. Summarize smart grid technologies and residential local area networks

Learning Objectives

17.a. Describe the various communication means used in the industry.
17.b. Explain what a smart grid is, how it works, how it impacts utility operations, and the benefits to customers.
17.c. Identify different networking applications.
17.d. Describe home/local area networks.
17.e. Explain how local area networks assist the line worker and utility.
17.f. Describe computerized systems which monitor utility operations.

18. Explain lightning arrestor lead lengths and installations for various situations

Learning Objectives

18.a. Describe the theory of lightning arrestors.
18.b. Compute lead lengths for given situations.
18.c. Evaluate installation requirements.
18.d. Describe relevant state and national electrical codes.
18.e. Rate effectiveness of arrestor lead lengths.
18.f. Diagram lead lengths.
18.g. Identify parts of a lightning arrestor.
18.h. Analyze the operation of a lightning arrestor

19. Explore street light maintenance and installation

Learning Objectives

19.a. Compare the types of outdoor lighting applications involved with the electrical utilities.
19.b. Describe the installation and maintenance requirements for street and roadway lights.
19.c. Compare the installation and maintenance requirements for sports fields and area lighting.
19.d. Identify specifications, regulations, and engineering of lighting systems and structures.
19.e. Explain the key principles associated with luminaries, lamps and structures.
19.f. Describe the role and function of lighting ballasts.
19.g. Compare lighting circuits and controls.
19.h. List the steps involved in troubleshooting and maintaining outdoor lighting systems.
19.i. Summarize the safety and environmental hazards associated with working on outdoor lights.
19.j. Relate street light maintenance and installation to the job duties and tasks performed by line workers.

50-413-715 Single Phase Equipment & Energized Line Safe Work Practices

Course Outcome Summary

Course Information

Alternate Title	Electric Utility Lineworker Apprenticeship Related Instruction Term 5 (Year 3)
Description	Apprentices will examine more of the National Electrical Safety Code and compare overhead construction techniques for primary and secondary lines. Course competencies also include concepts and principles associated with single phase power, equipment, and safe work practices for energized lines. Training in confined space entry and aerial rescue will be included in this course. Course provides 2 weeks of related instruction in a block scheduling format.
Career Cluster	Agriculture, Food and Natural Resources
Instructional Level	Technical Diploma
Total Credits	2.25
Total Hours	80.00

Types of Instruction

Instruction Type	Credits/Hours
Classroom presentation, demonstration, discussion and small group learning.	40 hours
School shop/lab/training center with hands-on learning.	40 hours

Purpose/Goals

Course provides related instruction for third year apprentices.

Target Population

This program is designed for students seeking employment as electrical line workers or electrical line worker apprentices.

Prerequisites

Prerequisite 50-413-714 and successful completion of years 1 and 2 is a suggested pre-requisite.

Course Competencies

1. Summarize the rules [electrical codes] for the installation and maintenance of overhead electric supply and communication lines (NESC Part 2).

Learning Objectives

1.a. Describe the purpose and scope of rules pertaining to electric supply and communication lines.
1.b. Compare the general requirements called for in the NESC.
1.c. Summarize the various classifications of lines and equipment
1.d. Identify the requirements for installation of equipment and devices.

1.e. Identify the clearance requirements.
1.f. Compare the grades of construction called for in the NESC.
1.g. Summarize loading requirements for grades B and C.
1.h. Describe the strength requirements called for in the NESC.
1.i. Explain the code requirements for line insulation.

2. Demonstrate skills used during construction of primary and secondary overhead power lines

Learning Objectives

2.a. Review types of line inspections.
2.b. Compare company specific construction standards.
2.c. Describe the construction requirements for overhead primary distribution lines.
2.d. Explain the construction requirements for overhead secondary distribution lines.
2.e. Explain the construction requirements for overhead transmission lines.
2.f. Clarify coordination requirements for working with other utilities.
2.g. Classify the characteristics of various pole options.
2.h. Describe the sequence of steps required to set poles.
2.i. Explain the types of guys used for overhead poles.
2.j. Compare the various anchors used in the trade.
2.k. Install anchors.
2.l. Install down guys.
2.m. Install crossarms for various situations.
2.n. Frame overhead poles.
2.o. String (or re-string) overhead power lines.
2.p. Summarize tying down conductors during construction and reconductoring.
2.q. Compare the pros and cons of various overhead transmission line foundation types.
2.r. List the steps required to assemble and erect transmission structures.
2.s. Explain the work required to install insulators and working with stringing blocks.
2.t. Describe the work required for installing conductors and related devices which are used in overhead transmission lines.
2.u. Perform pole top and bucket truck rescue procedures.
2.v. Describe predictive and preventative overhead line maintenance.

3. Demonstrate skills with replacing overhead single phase conductors

Learning Objectives

3.a. Identify safety procedures and PPE requirements for replacing conductors.
3.b. Describe the role and function of tools and equipment required to replace conductors.
3.c. List materials and supplies required for conductor replacement.
3.d. Compare types of connectors and how they are installed.
3.e. Build skills installing wedge type connectors.
3.f. Perform installation of compression connectors.
3.g. Install bolted connectors according to manufacturer specifications
3.h. List the sequence of steps in the correct order of first to last.
3.i. Build skills tying down conductors for given situations.

4. Demonstrate skills repairing downed power lines

Learning Objectives

4.a. Identify safe work practices and PPE requirements.
4.b. Explain the steps required for grounding power lines.
4.c. Compare bracket grounds and equal potential grounding for distribution lines.
4.d. Compare isolating and hold carding.
4.e. Verify energized or de-energized.
4.f. Compare methods for splicing conductors.
4.g. Explain rigging techniques, lifting, hoists, and moving lines overhead.
4.h. Describe communication and coordination with dispatch personnel.

5. Demonstrate skills with outages and restoring power in a simulation training scenario

Learning Objectives

5.a. Identify the common causes of power failures.

5.b. List possible remedies for each.
5.c. Describe critical steps involved in responding to power outages.
5.d. Identify PPE and safety requirements for responding to outages and restoring power.
5.e. Compare roles and responsibilities for lineworkers, and personnel/protocols involving power outages.
5.f. Identify the tools and equipment required for restoring power.
5.g. Summarize the job duties and tasks required.
5.h. Describe how to troubleshoot equipment and systems to rectify problems.
5.i. Build skills required to resolve power outages in a simulated training environment.

6. Demonstrate confined space safe work practices

Learning Objectives

6.a. Explain testing and metering of air quality.
6.b. Describe entering confined spaces.
6.c. Define what a confined space is.
6.d. Compare underground versus above-ground confined spaces.
6.e. Build skills required for confined space rescue techniques.
6.f. Summarize crew member roles & responsibilities.
6.g. Compare tagging and permitting.
6.h. Build skills required for properly entering manholes.
6.i. Review OSHA standards for entering manholes

7. Demonstrate skills with aerial rescue involving overhead power/transmission lines

Learning Objectives

7.a. Examine OSHA and related safety standards for aerial rescue involving overhead lines.
7.b. Perform pole top rescue procedures for overhead power lines.
7.c. Perform aerial rescue for overhead transmission lines.
7.d. Perform bucket truck rescue procedures for overhead situations.
7.e. Estimate tower heights and identify rescue resources needed.

8. Explore single phase distribution transformers connections and installations

Learning Objectives

8.a. Compare transformer settings.
8.b. Examine loads and load calculations.
8.c. Illustrate single phase transformer connections.
8.d. Define primary and secondary voltage arrangements.
8.e. Describe the role and function of single phase transformers in distribution.
8.f. Relate transformer concepts to utility applications.
8.g. Explain transformer taps.
8.h. Illustrate transformer polarity and testing.
8.i. Identify transformer connections.
8.j. Build skills conducting electrical tests on transformers.
8.k. Describe the transformation effect on current.
8.l. Explain transformer losses and impedance.
8.m. Compare methods for protecting transformers.
8.n. Compare single phase transformer connections.
8.o. Identify safety and PPE requirements for installing and servicing single phase distribution transformers.
8.p. Outline troubleshooting strategies for working with faulty devices.

9. Perform skills required for installing single phase transformers and verifying operations

Learning Objectives

9.a. Explain the purpose of a transformer in a distribution system.
9.b. Compare voltages associated with transformers
9.c. Describe transformer settings and their applications in the field
9.d. Interpret transformer name plates
9.e. Identify Wye and Delta
9.f. Explain bushings and components used in transformers
9.g. Compare construction & design,
9.h. Describe transformer installation

9.i. Summarize servicing
9.j. Explain troubleshooting procedures for malfunctioning transformers
9.k. Compare two bushing and single bushing transformers.
9.l. Describe grounding requirements for single bushing transformers.
9.m. List the correct sequence of energizing a transformer

10. Test single phase transformers and verify proper operation

Learning Objectives

10.a. Test for impedance
10.b. Test for polarity
10.c. Test for voltage ratios
10.d. Relate test results to coil configuration before placing into service.
10.e. Interpret test results.
10.f. Verify operational specifications.

11. Compare the risks, hazards, safeguards and procedures when working with potential back-feeds

Learning Objectives

11.a. Illustrate how back feeds occur in distribution and transmission.
11.b. Identify the risks and hazards associated with back feeds.
11.c. List the safety requirements associated with protecting workers against back feed risks.
11.d. Describe procedures for isolating equipment and lines.
11.e. Summarize the role customers can play in back feeds.
11.f. Explain how to test and verify potential back feeds.
11.g. Explain grounding requirements for protecting workers and equipment.

12. Troubleshoot single phase equipment and devices

Learning Objectives

12.a. Describe the troubleshooting step of analyzing, or separating the whole item into its component parts, examine each component, and interpret the significance, contribution, or impact of each as a part of the whole.
12.b. Explain the troubleshooting step of checking as a means to verify proper operation.
12.c. Compare methods for describing the problem including recounting, characterizing, sketching or relating in a narrative form.
12.d. Explain how to differentiate as a means to state the difference between or among the item in question.
12.e. Compare how to clarify and interpret the 'how' and 'why' information you present as a possible explanation of causes.
12.f. Describe methods to illustrate as a means to explaining or clarifying responses to the problem.
12.g. Summarize Inspection methods as a means to examine the problem by using all five senses as applicable.
12.h. Express how maintaining relates to troubleshooting and is a means to perform functions that ensure continued operation.
12.i. Describe how overhauling is a means to disassemble, inspect, repair as necessary and check.
12.j. Summarize how repair is a means to correct a defective condition.
12.k. Relate how service is a means to performing functions that ensure continued operation.
12.l. Relate troubleshooting as a means to analyze and identify malfunctions.
12.m. Examine the use of a remedy chart as a resource for line workers involved in troubleshooting.

13. Examine overcurrent protection and protective devices.

Learning Objectives

13.a. Compare use and types of fuses.
13.b. Describe fuse coordination.
13.c. Explain the role and function of OCR’s
13.d. Describe the role and function of sectionalizers
13.e. List the steps involved to replace fuses.
13.f. Examine causes of faults and fault detection.
13.g. Troubleshoot faults and outages.

14. Summarize the role and function of voltage regulators in single phase applications

Learning Objectives

14.a. Describe the role and function of single phase voltage regulators.
14.b. Explain safe work practices and PPE requirements for working with voltage regulators.
14.c. Summarize the work required for installing and putting voltage regulators into service.
14.d. Outline the steps and tasks removing voltage regulators from service.
14.e. Compare settings and control panels associated with voltage regulators.
14.f. Interpret information found on dial indicator.

15. Compare the construction and operation of transmission lines and equipment

Learning Objectives

15.a. Identify the types of towers used for transmission.
15.b. Compare tower construction standards.
15.c. Describe tower bases and footings used for transmission.
15.d. Identify conductors used in transmission.
15.e. Summarize construction techniques used in transmission.
15.f. Describe the use of pulling rigs.
15.g. Estimate tower distances and sag requirements.
15.h. Explain wood pole construction practices.
15.i. Explain steel pole construction practices.
15.j. Compare vertical and horizontal construction applications.
15.k. List environmental considerations and challenges.

16. Compare construction standards used by utilities

Learning Objectives

16.a. Compare materials of construction used in primary and secondary lines.
16.b. Contrast the various classes of poles.
16.c. List the advantages and disadvantages of each type of pole.
16.d. Describe the limitations for each type of pole.
16.e. Summarize company construction standards.
16.f. Summarize selected equipment and material manufacturer's specifications for construction.

17. Examine safe work practices for energized lines and equipment

Learning Objectives

17.a. Identify safe work practices and PPE requirements for working with energized lines.
17.b. Describe the process to visually inspect physical damage to energized lines and equipment.
17.c. Summarize the steps for isolating energized lines.
17.d. Explain the procedures for installing and removing protective grounds.
17.e. Describe steps for dismantling and removing overhead energized equipment.
17.f. Build skills related to dismantling and removing overhead energized equipment (simulated).
17.g. Explain the work required to restore areas to their original condition.
17.h. Summarize the procedure to remove capacitors from service.
17.i. Demonstrate skills using switch sticks, hot sticks, and other tools for energized line work.

18. Demonstrate skills required for pole framing and cross-arm change outs on power lines

Learning Objectives

18.a. Compare pole framing on de-energized and energized power lines
18.b. Describe cross arm change out on both energized and de-energized lines.
18.c. Summarize work processes for energized.
18.d. Summarize work processes for de-energized.
18.e. Compare how to change it hot instead of de-energized.

19. Demonstrate skills required for dead end insulator change outs on energized lines

Learning Objectives

19.a. Describe rubber cover-up needed for the job.
19.b. Identify proper sag required for various situations.
19.c. Name the appropriate tools associated with each operation.
19.d. Build skills sagging conductors.
19.e. Build skills installing jumpers.

19.f. Build skills cutting in a double dead-end primary split.

20. Demonstrate skills required for jumper change outs on energized lines

Learning Objectives

20.a. Install bypass with temporary mechanical jumpers
20.b. Describe rubber cover-up needed for the job.
20.c. Identify safe work practices and PPE requirements.
20.d. Remove the old jumper
20.e. Remove old connectors on lines and cross arms
20.f. Replace or install new jumper with appropriate connectors.
20.g. Explain use of jumper tie downs as needed.

50-413-716 Poly Phase Equipment & Construction

Course Outcome Summary

Course Information

Alternate Title	Electric Utility Lineworker Apprenticeship Related instruction Term 6 Year 3)
Description	Course examines poly phase equipment, apparatus and construction. Course competencies explore transformers, grounding requirements, load calculations, safety, and related concepts. OSHA 1910.269 and a review of 1st & 2nd years is included. Course provides 2 weeks of related instruction in a block schedule format.
Career Cluster	Agriculture, Food and Natural Resources
Instructional Level	Technical Diploma
Total Credits	2.25
Total Hours	80.00

Types of Instruction

Instruction Type	Credits/Hours
Classroom presentation, demonstration, discussion and small group learning.	40 hours
School shop/lab/training center with hands-on learning.	40 hours

Purpose/Goals

Course provides related instruction for third year apprentices.

Target Population

This program is designed for students seeking employment as electrical line workers or electrical line worker apprentices.

Prerequisites

Prerequisite 50-413-715 and successful completion of first and second years is a suggested pre-requisite.

Course Competencies

1. Relate the NESC work rules for the installation, maintenance and operation of electric supply lines and equipment to OSHA safety standards (NESC Appendix B)

Learning Objectives

1.a. Compare NESC work rules to telecommunications operations and maintenance (OSHA 1910.268).
1.b. Distinguish NESC work rules to the operation and maintenance of electric power generation, transmission, and distribution (OSHA 1910.269 with Appendices A-E).
1.c. Relate NESC work rules to the construction of power transmission and distribution equipment (OSHA 1926.950 - 990 and Subpart V).

1.d. Summarize critical job duties and tasks required of line workers which are impacted by these rules and standards.
1.e. Identify responsibilities for owners, managers, employees and suppliers related to NESC work rules and OSHA standards.

2. Examine three phase transformer characteristics

Learning Objectives

2.a. Compare three phase transformer settings.
2.b. Examine three phase load.
2.c. Explain three phase Delta and Wye characteristics.
2.d. Describe three vectoring and paralleling banks.
2.e. Summarize open delta banks.
2.f. Illustrate three phase transformer connections.
2.g. Define primary and secondary voltage arrangements.
2.h. Outline troubleshooting procedures for three phase transformers.
2.i. Explain rotation and the skills required to perform related job tasks.
2.j. Build skills pertaining to determining three phase transformer settings.
2.k. Build skills pertaining to rotation.

3. Apply electrical theory to three phase characteristics

Learning Objectives

3.a. Explore the reasons for different three phase connected systems.
3.b. Compare the different three phase systems.
3.c. Distinguish the primary phases and the primary neutral.
3.d. Diagram the difference between single phase and three phase.
3.e. Investigate the purpose of three phase system.
3.f. Identify the apprentices' three phase systems at their utility.

4. Calculate three phase loads

Learning Objectives

4.a. Explain three phase volt-amps.
4.b. Describe three phase watts.
4.c. Summarize three phase volt-amps reactive.
4.d. Explain three phase power factor.
4.e. Describe three phase, phase angle.
4.f. Calculate three phase volt-amps.
4.g. Calculate three phase watts.
4.h. Calculate three phase volt-amps reactive.
4.i. Calculate three phase power factor.
4.j. Calculate three phase, phase angle.
4.k. Determine system efficiency.
4.l. Explain the importance of near zero phase angle and/or near one-hundred percent power factor.

5. Examine three phase banking operations & safety

Learning Objectives

5.a. Differentiate between a paralleled single phase transformer bank compared to a three phase transformer bank
5.b. Compare the purpose of a paralleled single phase transformer bank to a three phase transformer bank
5.c. Explain line voltages
5.d. Explain coil voltages
5.e. Explain line currents
5.f. Explain coil currents

6. Explore three phase grounding requirements

Learning Objectives

6.a. Define terms such as neutral point of an electrical supply system, earth ground, ground and neutrals.
6.b. Identify conductor used in three phase grounding requirements.
6.c. Describe the how current is carried on a grounding conductor can damage equipment or injure people.

6.d. Compare electrical codes related to grounding in three phase applications.
6.e. Compare grounding circuitry for three phase
6.f. Compare earthing systems
6.g. Describe means to combine neutral with earth.
6.h. Analyze shared neutral in three phase circuits.
6.i. Describe split phase applications.

7. Demonstrate skills working on high voltage three phase equipment safely

Learning Objectives

7.a. Demonstrate the back feed primary voltage with a three phase motor load connected to a 240 volt single phase resistive load.
7.b. Measure the back fed primary voltage using an analog or digital phasing stick with a three phase motor load connected to a 240 volt single phase resistive load.
7.c. Illustrate the reason the bank back feeds with a three phase motor load and a 240 volt single phase resistive load connected to the secondary.
7.d. Demonstrate the back feed primary voltage with a 480 volt three phase motor load and 277 volt single phase resistive load connected to the secondary.
7.e. Measure the back fed primary voltage using an analog or digital phasing stick with a 480 volt three phase motor load and a 277 volt single phase resistive load connected to the secondary.
7.f. Illustrate the reason the bank back feeds with a 480 volt three phase motor load and a 277 volt single.
7.g. Summarize the safety a lineworker needs to take to prevent and accident or an accidental contact with a back fed primary phase.

8. Demonstrate skills with replacing three phase conductors

Learning Objectives

8.a. Identify safety procedures and PPE requirements for replacing three phase conductors.
8.b. Describe the role and function of tools and equipment required to replace conductors.
8.c. List materials and supplies required for conductor replacement.
8.d. Compare types of connectors and how they are installed.
8.e. Build skills installing connectors.
8.f. Perform installation of compression connectors.
8.g. Install bolted connectors according to manufacturer specifications
8.h. List the sequence of steps in the correct order of first to last.
8.i. Build skills tying down conductors for given situations.

9. Test three phase transformers and verify proper operation

Learning Objectives

9.a. Explain how to connect a grounded wye-delta three wire transformer bank
9.b. Illustrate how to connect a grounded wye-delta three wire transformer bank
9.c. Discover the purpose of the grounded wye-delta three wire transformer bank
9.d. Compose and document job briefing
9.e. Construct a grounded grounded wye-delta three wire transformer bank
9.f. Expose the apprentice to an energized three phase transformer bank
9.g. Identify the secondary line voltages between phase to phase
9.h. Measure the secondary line voltages between phase to phase using a 600 volt rated meter
9.i. Review the grounded wye-delta three wire transformer bank characteristics.

10. Troubleshoot three phase equipment and devices

Learning Objectives

10.a. Construct a grounded wye-delta three wire transformer bank.
10.b. Discuss the ability for a transformer to back feed with a grounded H2 ,one (1) de-energized primary phase and the secondary, no secondary load connected.
10.c. Discuss the ability for this transformer to back feed with an ungrounded H2 and one (1) de-energized primary phase.
10.d. Identify dangerous situations this transformer bank can put a Lineworker in during a back feed.
10.e. Compose and document a job briefing related to troubleshooting 3 phase equipment.
10.f. Explain troubleshooting energized three phase transformer bank with a grounded H2 and one (1) de-energized phase.

10.g. Simulate the back feed with a grounded H2 and one (1) de-energized primary phase.
10.h. Measure the back fed primary voltage using an analog or digital phasing stick.
10.i. Illustrate the reason the bank back feeds.
10.j. Compare industry practices for troubleshooting three phase equipment and devices.

11. Apply customer service skills to various utility situations and scenarios

Learning Objectives

11.a. Explain why listening is especially important when you work with others.
11.b. Describe the importance of maintaining eye contact and the effects of keeping and or not keeping eye contact while listening.
11.c. Describe some common "body language" signals.
11.d. Describe levels of listening.
11.e. Define effective listening.
11.f. Describe the four types of listening.
11.g. Select listening strategies that are appropriate for various situations.
11.h. Examine bad listening habits that result in listening problems.
11.i. Describe how non-directive listening can be supportive.
11.j. Use non-directive listening techniques including: summarizing, paraphrasing, using minimal encouraging, empathizing, clarifying, making appropriate comments.

50-413-717 Poly Phase Power Fundamentals, Substations, and Metering

Course Outcome Summary

Course Information

Alternate Title	Electric Utility Lineworker Apprenticeship Related Instruction Term 7 (Year 4)
Description	Competencies and learning objectives in this course include three phase power; banking operations, safety; back-feeds; and high voltage. A transformer apparatus school and overhead school are included. Applicable OSHA 1910.269 requirements are reviewed and practiced. This course also examines energized line work, substation operations and switching, three-phase metering applications and green energy power generation equipment or systems. A review of applicable OSHA 1910.269 requirements and years 1-3 of related instruction are included. Customer service skills are reinforced and applied to roles for line workers. Course provides 2 weeks of related instruction in a block scheduling format.
Career Cluster	Agriculture, Food and Natural Resources
Instructional Level	Technical Diploma
Total Credits	2.25
Total Hours	80.00

Types of Instruction

Instruction Type	Credits/Hours
Classroom presentation, demonstration, discussion and small group learning.	40 hours
School shop/lab/training center with hands-on learning.	40 hours

Purpose/Goals

Course provides related instruction for fourth year apprentices.

Target Population

This program is designed for students seeking employment as electrical line workers or electrical line worker apprentices.

Prerequisites

Prerequisite 50-413-716 and successful completion of years 1,2 and 3.

Course Competencies

1. Compare and contrast three phase transformer settings

Learning Objectives

1.a. Discover the purpose of an ungrounded wye-delta four wire transformer bank.
1.b. Review the ungrounded wye-delta four wire transformer bank characteristics.
1.c. Explain how to connect an ungrounded wye-delta four wire transformer bank.
1.d. Illustrate how to connect an ungrounded wye-delta four wire transformer bank.
1.e. Explain how to connect an open wye-open delta four wire transformer bank.
1.f. Illustrate how to connect an open wye-open delta four wire transformer bank.
1.g. Discover the purpose of an open wye-open delta four wire transformer bank.
1.h. Conduct a job briefing on transformer connections.
1.i. Examine energized three phase transformer banks.
1.j. Review the open wye-open delta four wire transformer bank characteristics.
1.k. Distinguish a Scott connection transformer bank.
1.l. Examine the variety of Scott connections.

2. Examine three phase characteristics

Learning Objectives

2.a. Demonstrate the use of personal protective equipment required within reaching distances of primary and secondary voltages.
2.b. Measure primary voltages between primary phases.
2.c. Measure primary voltages between phase to neutral.
2.d. Identify the secondary line voltages between phase to phase.
2.e. Measure the secondary line voltages between phase to phase using a 600 volt rated meter.
2.f. Measure the secondary line currents using a 600 volt rated amp meter.
2.g. Calculate primary line current.
2.h. Calculate primary coil current

3. Explore open delta banks

Learning Objectives

3.a. Identify dangerous situations this transformer bank can put a lineworker in during a back feed.
3.b. Diagram an ungrounded wye system.
3.c. Explain an ungrounded wye system.
3.d. Diagram a grounded wye system.
3.e. Explain a grounded wye system.
3.f. Diagram a delta system.
3.g. Explain a delta wye system.

4. Diagram angular displacement

Learning Objectives

4.a. Explain the principle and concepts related to angular displacement.
4.b. Describe the purpose of differences between the 0-degree and a 180-degree angular displacements.
4.c. Explain the purpose of difference between the 30-degree and a 210-degree angular displacements.
4.d. Analyze a 30-degree angular displacement three phase transformer bank.
4.e. Diagram a 30-degree angular displacement three phase transformer bank.
4.f. Analyze a 210-degree angular displacement three phase transformer bank.
4.g. Diagram a 210-degree angular displacement three phase transformer bank.
4.h. Explore a 0-degree angular displacement three phase transformer bank.
4.i. Diagram a 0-degree angular displacement three phase transformer bank.
4.j. Explore a 180-degree angular displacement three phase transformer bank.
4.k. Diagram a 180-degree angular displacement three phase transformer bank.
4.l. Compare the different connections between 30-degree and 210-degree angular displacements.
4.m. Compare the different connections between 0-degree and 180-degree angular displacements.

5. Construct three phase transformer settings

Learning Objectives

5.a. Construct a wye-delta three wire transformer bank.
5.b. Construct a wye-delta four wire transformer bank.
5.c. Construct an open wye-open delta three wire transformer bank.
5.d. Construct an open wye-open delta four wire transformer bank.

5.e. Construct a wye-wye four wire transformer bank.

6. Apply three phase fundamentals to vectoring and paralleling banks

Learning Objectives

6.a. Categorize high voltage and low voltage winding configurations found in three-phase transformers.
6.b. Describe vector group designations, symbols, and terminology.
6.c. Compare phase windings of polyphase transformer connections and configurations.
6.d. Compare three wire and four wire systems.
6.e. Interpret transformer manufacturer specifications and technical information.
6.f. Examine various combinations of winding connections will result in different phase angles.
6.g. Explain transformer configurations connected in parallel.
6.h. Relate mismatched phase angles to system disturbances and problems.
6.i. Interpret symbols and designations associated with vectoring and parallel transformers.
6.j. Explain phase displacement.

7. Troubleshoot customer problems and faults associated with three phase

Learning Objectives

7.a. Analyze multiple three phase transformer banking accidents and close calls.
7.b. Outline the job procedures which lead up to each safety incident.
7.c. Answer the question - what is the line worker's opinion of what the issue was which resulted in the safety issue.
7.d. Examine what the proper work procedures should have been.
7.e. Identify safety rules from their company's safety manual and work procedures which pertains to the safety incidents.

8. Examine safety requirements for working with substation equipment, operations and switching

Learning Objectives

8.a. Answer the question; what is a substation and its function.
8.b. Describe safety requirements which are applicable to substations.
8.c. Identify the role and function of substation equipment, components and devices.
8.d. Explain the role for lineworkers related to installing, servicing, repairing, and upgrading substations.
8.e. Build skills reading substation maps.

9. Explore substation map reading

Learning Objectives

9.a. Compare company maps associated with substations.
9.b. Interpret the map legend, title block and related information.
9.c. Locate borders, barriers and other geographic information found on maps.
9.d. Identify powerlines in and out of substations.
9.e. Interpret symbols used for physical attributes found inside substations.
9.f. Explain how underground cables and equipment are expressed in maps.
9.g. Identify control buildings and structures.
9.h. Examine how GIS and GPS technologies interface with maps.
9.i. Summarize how substation maps are one of the tools available to lineworkers.

10. Plan for substation equipment maintenance, servicing and troubleshooting

Learning Objectives

10.a. Identify PPE requirements and safe work practices for substation related duties & tasks.
10.b. List the types of substation equipment which requires routine maintenance and service.
10.c. Match maintenance requirements to each type of equipment.
10.d. Compare maintenance requirements for different substations.
10.e. Outline the sequence of operations for servicing substation equipment.
10.f. Apply troubleshooting procedures to substations.
10.g. Compare substation faults and interruptions in power.
10.h. Describe substation construction standards for various applications.

11. Demonstrate skills required for substation switching

Learning Objectives

11.a. Summarize substation switching procedures for various situations.
11.b. Explain why and when substation switching is scheduled.
11.c. Define sequence of operations, and apply the concept to substation switching.
11.d. Identify safety and PPE requirements for substations switching operations.
11.e. Summarize the knowledge, skills and abilities that lineworkers need to perform substation switching.

12. Demonstrate skills working with three phase meters

Learning Objectives

12.a. Explain common wiring procedures for single phase meters.
12.b. Describe required wiring procedures for 3-phase meters.
12.c. Compare wiring of various meter sockets.
12.d. List the tools, equipment and resources required to wire meters.
12.e. Interpret meter diagrams for various installations.
12.f. Compare configuration requirements for various meter sockets.
12.g. Perform meter wiring for form 2s.
12.h. Wire a meter for form 3s.
12.i. Wire a meter for form 4s.
12.j. Wire a meter for form 5s.
12.k. Wire a meter for form 6s.
12.l. Wire a meter for form 8s.
12.m. Wire a meter for form 12s.
12.n. Summarize troubleshooting steps for meters with various configuration requirements.

13. Apply NESC codes to three phase metering installations and trade work practices

Learning Objectives

13.a. Identify PPE requirements and safe work practices for three phase metering.
13.b. Locate three phase meter related codes found in the NESC.
13.c. Compare company standards for three phase meter work, and their relationship to electrical codes.
13.d. Describe how the code directs work performed by the trade.
13.e. Explain how three phase meters are installed according to code.
13.f. Summarize how three phase meters are serviced following NESC.
13.g. List troubleshooting techniques for three phase meters which adhere to NESC.
13.h. Compare meter installation options which conform to electrical codes.

14. Explore emerging technologies and work requirements for renewable distributed energy generation

Learning Objectives

14.a. Describe solar array installations.
14.b. Compare wind farms and collector systems.
14.c. List the advantages and disadvantages of RDG technologies.
14.d. Identify the specific system requirements for RDG.
14.e. Identify distributed generation interconnections, distribution, and transmission.
14.f. Describe isolating switches and the intent of isolation.
14.g. Identify correct wiring and proper connections.
14.h. Summarize physical connections, interconnects, and disconnects.
14.i. Explain the proper techniques for connecting and disconnecting RDG interconnected systems on the utility's grid.
14.j. Compute load calculations and size transformers and service lines.
14.k. Apply safety rules when working on de-energized lines with the potential of backfeed from renewable distributed generation (RDG).
14.l. Describe the proper safety procedures related to distributed generation (RDG) sources.
14.m. Explain the potential hazards caused by reverse power flow, backfeeds, and other RDG safety items.
14.n. Distinguish between safe and unsafe conditions.
14.o. Explain how the inverter is designed to prevent backflow on a de-energized line.
14.p. Troubleshoot utility equipment associated with interconnected renewable energy generators safely.
14.q. Explain anti-islanding and how to test this function.
14.r. Summarize disconnecting means as they apply to protecting workers, equipment, and property.
14.s. Analyze a case study or scenario involving a work accident which resulted in injury or death, or damage to equipment and property.

50-413-718 Emergency Response for Lineworkers, Renewable Energy & Capstone Project

Course Outcome Summary

Course Information

Alternate Title	Electric Utility Lineworker Apprenticeship Related Instruction Term 8 (Year 4)
Description	Course competencies and learning objectives focus on emergency response roles for line workers and preparing the apprentice for a transition to journey level work. A hands-on learning activity involving a car/pole accident response simulation provides for capstone project learning experiences. Course also reviews for the JW exam offered through the college. Apprentices will complete a renewable & green energy research project and presentation as a second capstone learning experience. The Transition to Trainer course is also taught during this term. Course provides 2 weeks of related instruction in a block scheduling format.
Career Cluster	Agriculture, Food and Natural Resources
Instructional Level	Technical Diploma
Total Credits	2.00
Total Hours	72.00

Types of Instruction

Instruction Type	Credits/Hours
Classroom presentation, demonstration, discussion and small group learning.	36 hours
School shop/lab/training center with hands-on learning.	36 hours

Purpose/Goals

Course provides related instruction for fourth year apprentices.

Target Population

This program is designed for students seeking employment as electrical line workers or electrical line worker apprentices.

Prerequisites

Prerequisite 50-413-717 and successful completion of years 1,2 and 3 are suggested pre-requisites.

Course Competencies

1. Apply the rules [electrical codes] for the installation and operation of electric supply equipment

and devices (NESC Appendix A).

Learning Objectives

1.a. Identify the application of NESC requirements for installation of equipment and devices selected by the instructor from Appendix A.
1.b. Identify the application of NESC requirements for maintenance of equipment and devices selected by the instructor from Appendix A.
1.c. Explain the application of code requirements for grounding devices.
1.d. Summarize the application of code requirements for underground lines and equipment.
1.e. Describe the application of code requirements for overhead lines and equipment.
1.f. Explain the application of code requirements for substations.
1.g. Compare the application of code requirements for circuit breakers, reclosers, switches and fuses.
1.h. Summarize the application of code requirements for clearances.
1.i. Describe the application of code requirements for transformers.

2. Investigate emergency response roles and responsibilities for line workers

Learning Objectives

2.a. List the possible outcomes of an accident which involves power lines.
2.b. Identify who is impacted and how.
2.c. Describe steps required for responding to accidents involving power lines.
2.d. Explain the roles for utilities, EMS, fire, police, and others.
2.e. Summarize the types of tools, equipment and resources that might be required to support an accident response by line workers.

3. Plan an emergency response to a car/pole scenario selected by the instructor

Learning Objectives

3.a. Outline a plan of action for a utility response to a car/pole accident.
3.b. Explain the requirements for coordinating with fire, police, EMS/EMT's, and local municipalities.
3.c. Describe how customers could be impacted and how to communicate with those affected by the accident.
3.d. List traffic control measures.
3.e. Summarize the sequence of steps required to isolate lines.
3.f. Flowchart the repair procedures.
3.g. Describe the replacement procedures.
3.h. Identify team roles for each member of the crew responding.
3.i. Identify safety protocols and PPE requirements.
3.j. List all the resources required for the accident response and repair.

4. Respond to a car-pole accident safely in accordance with industry practices

Learning Objectives

4.a. Respond to a simulated training scenario involving a car/pole accident.
4.b. Assess the situation.
4.c. Formulate an action plan.
4.d. Plan a sequence of steps.
4.e. Select equipment, tools, and needed resources.
4.f. Communicate intended actions before performing them.
4.g. Coordinate work with others.
4.h. Manage time and resources effectively.
4.i. Remove and replace devices as needed.
4.j. Restore power quickly and safely.

5. Relate the results of the emergency response to continuous improvement

Learning Objectives

5.a. Report on the emergency response actions taken by lineworkers.
5.b. Describe what worked well and what didn't.
5.c. Identify which areas requirement corrective action and improvement.
5.d. Explain what should have happened for those areas that need improvement.
5.e. Describe what you and/or the crew would do differently in the future.
5.f. Summarize the response in a written format used by the trade and/or utility industry.

6. Investigate renewable energy & green technologies being employed by businesses and residential customers

Learning Objectives

6.a. Select a topic related to green or renewable energy.
6.b. Describe how the technology is impacting the grid, utilities, customers and the trade.
6.c. List the major drivers behind the selected technology.
6.d. Identify the major barriers facing the selected technology.
6.e. Explain how work practices are changing as a result of the selected technology being adopted.
6.f. Conduct internet searches and locate appropriate resources.
6.g. Review information.
6.h. Summarize findings.
6.i. Organize and prepare an in-class presentation.
6.j. Create presentation graphics, summary information and speaking points.
6.k. Deliver presentation.
6.l. Submit a written summary to the instructor if directed to do so.

7. Investigate an emerging trend or technology impacting the field/occupation

Learning Objectives

7.a. Select a topic of interest related to an emerging trend or technology impacting the trade.
7.b. Discuss the topic with your instructor and obtain approval to investigate it.
7.c. Research the topic by reviewing industry resources and credible websites.
7.d. Interview a qualified individual who works in the area selected.
7.e. Describe how the trend or technology is impacting the utilities.
7.f. Explain how the trend or technology is impacting customers and users.
7.g. List the advantages and disadvantages of the trend or technology.
7.h. Summarize your findings.
7.i. Present your summary via a written and/or oral presentation to your class.
7.j. Submit your report to the instructor for review and feedback.

8. Prepare for your role as a journey level worker in the trade

Learning Objectives

8.a. Review your apprenticeship training and related instruction coursework.
8.b. Revisit areas of concern and clarify any areas which are confusing.
8.c. Complete both a written and hands-on exam covering all four years.
8.d. Compare the job duties and tasks performed by JW's in the trade to the work performed by apprentices.
8.e. Reflect on the training roles performed by JW's.
8.f. Apply leadership skills to roles performed by JW's.
8.g. Plan your transition steps from apprentice to journey level worker.
8.h. Identify future areas of interest and opportunities for continuing education and professional development.

47-455-455 Transition to Trainer: Your Role as a Journey Worker

Course Outcome Summary

Course Information

Description Apprenticeship training is a collaborative partnership: employer and employee associations, government, and educational institutions each play a part. In reality, most learning takes place through the daily interaction between an apprentice and his/her co-workers. Surveys have shown that the apprentices are least satisfied with the on-the-job portion of their training--particularly the ability of journey level workers and supervisors to pass on their knowledge of the trade.

You have already learned to use the tools of your chosen trade. In this workshop you will be introduced to a new set of basic tools--the tools of a jobsite trainer. You will explore the skills that are necessary to be an effective trainer, discover how to deliver hands-on training, and examine the process for giving useful feedback. During the workshop you will build a Training Toolkit to take back to your work on the job.

Total Hours 8.00

Types of Instruction

Instruction Type	Credits/Hours
Workshop	

Target Population

Transition to Trainer is designed for all apprentices who are approaching the end of their related instruction as well as for journey level workers who are or will be training apprentices.

Course Competencies

1. Value your role as a journey worker trainer

Assessment Strategies

1.1. by recording the appropriate information in your Training Toolkit

Criteria

The quality measures that show you can perform the skill:

1.1. you describe the role of the journey worker in training an apprentice
1.2. you explore benefits of training an apprentice
1.3. you examine why the journey worker is a key player in the training process
1.4. you identify the skills you bring to the training process

Learning Objectives

1.a. Examine the apprentice training model.
1.b. Describe the role of the journey worker as trainer.
1.c. List benefits of acting as a journey worker trainer
1.d. Identify the responsibilities of a journey worker trainer.

2. Serve as a mentor and job coach

Assessment Strategies

2.1. by recording the appropriate information in your Training Toolkit

Criteria

The quality measures that show you can perform the skill:

2.1. you describe employer expectations
2.2. you describe co-worker expectations
2.3. you describe what the apprentice can expect from the employer
2.4. you suggest ways to promote safety training
2.5. you create a checklist of things to address with an apprentice during the first week
2.6. you prepare a list of terms that are necessary for safety and training in your trade
2.7. you determine the strengths you bring to the mentoring relationship

Learning Objectives

2.a. List the characteristics of a good mentor.
2.b. Identify the benefits of mentoring.
2.c. Identify employer and co-worker expectations.
2.d. Identify the expectations of the apprentice.
2.e. List the items to cover in an apprentice orientation.

3. Foster a positive work environment by acting as an ally/advocate

Assessment Strategies

3.1. by responding to case study scenarios

Criteria

Your performance will be successful when:

3.1. response accurately identifies the issue present in the scenario
3.2. response presents effective strategies for putting a stop to inappropriate actions
3.3. response works within the organizational chain of command
3.4. response provides support for the apprentice
3.5. response shows tact
3.6. response does not lay blame

Learning Objectives

3.a. Describe a positive work setting
3.b. Define diversity
3.c. Recognize your own biases
3.d. Differentiate among perpetrator, target, bystander, and ally/advocate
3.e. Provide support for apprentices
3.f. Identify strategies for deterring inappropriate situations
3.g. Outline the chain of command for reporting

4. Provide hands-on skills training

Assessment Strategies

4.1. by completing the Training Plan for Apprentices

Criteria

The quality measures that show you can perform the skill:

4.1. you motivate the apprentice by explaining why the skill is important
4.2. you instruct on the use and care of tools and equipment
4.3. you point out safety precautions
4.4. you explain how to perform the task
4.5. you demonstrate each step of the task
4.6. you watch the apprentice try to perform the task
4.7. you provide positive feedback and suggestions for improvement

Learning Objectives

4.a. Describe the process for teaching someone a skill: motivate, explain, demonstrate, try, evaluate.
4.b. Explain the importance of guided practice in the teaching process.
4.c. Describe how related instruction relates to the job.
4.d. List potential job hazards and other safety information that applies to a task.
4.e. Apply the training process steps to a situation.

5. Provide feedback on apprentice performance

Assessment Strategies

5.1. by giving feedback in a role playing situation

Criteria

The quality measures that show you can perform the skill:

5.1. you describe what the apprentice did
5.2. you express your reaction to the situation
5.3. you specify what you want done
5.4. you describe what will happen (positive or negative) if the behavior does/does not improve

Learning Objectives

5.a. Describe the importance of feedback to skill development.
5.b. Explain the importance of frequent feedback.
5.c. Examine a model for giving feedback.
5.d. Apply the model for giving feedback.