
Meter Technician

Program Duration: 4 Years (48 Months)

The following is an outline of the subjects to be covered in the supplementary classroom and home study training:

<u>Process</u>	<u>Hours</u>
Meter Shop Safety	100
Single Phase Shop Testing	400
Poly Phase Shop Testing	600
Wiring New Meter Sets	
- Secondary	1600
- Primary	240
Field Testing	
- Mainlines	1600
- In Service Checks	560
Field Inspections	
- Solar and Battery Installations	1600
- Troubleshooting/Exchanges	980
Meter Dispatching	40
Trade Schools	120
Cross Training	
- Billing	20
- Trouble Dispatch	20
- Lines	40
- Telecommunications	40
- Substation	40
Total OJT Hours Recommended	8000

Course Plan

First Six Months

Familiarize candidates by reviewing math courses that are focused on algebra, geometry, trigonometry, and expose candidates to basic electric safety practices.

Second Six Months

Acquaint candidates with D/C electrical principles, A/C circuitry and electromagnetism, both of which are essential for the successful operation of induction meters used mainly on residential and some commercial/industrial customers. Additional training will be provided in proper dealings with customers so they can present a good image of the Company to the public. Energy diversion classes are taught to arm the apprentice with the ability to help curtail power theft.

Third Six Months

Familiarization with electronic components and electronic measurements is emphasized. Self-contained metering and their proper installation are also taught during this period. Candidates are given an introductory course into computer hardware and how to use common computer applications, including meter programming software.

Fourth Six Months

Transformers and instrument transformers that are used to supply power to commercial/industrial customers and facilitate metering of this power are introduced. Reading and understanding schematics as presented on blueprints and one-line diagrams is also given special attention.

Fifth Six Months

The apprentice will review substations, local distribution, and underground power systems. Electrical parameters and quantities measured in a power system are also introduced.

Sixth Six Months

Polyphase systems, polyphase metering, and demand metering are discussed during this term.

Seventh Six Month

Specialized metering such as reactive, Q, V2H, and other metering quantities are treated in some detail. Mechanical and solid-state relaying transducers, and solid-state power supplies are studied. This will equip candidates with the knowledge of how load management and conservation information is provided to commercial/residential customers and to SCADA systems.

Eighth Six Months

Advanced metering is introduced to candidates to prepare them to perform independently in the shop and in the field. This includes totalizing meters, all solid-state meters, multi-tariff meters, electronic recorders, and other specialized instruments. During this period, candidates are expected to get the formal hands-on training through direct supervision and assisting meter technicians in the field.

The following is an outline of the subjects to be covered in the supplementary classroom and home study training:

Supplementary Classroom Training

First Six Months

Safety in Meter Work (NUS)
Safety in Sub/Switch Yards (NUS)
Fractions, Percents, Proportions, Angles (ICS)
Formulas (ICS)
Introduction to Algebra (ICS)
Monomials and Polynomials
Algebra Factoring (ICS)
Addition and Subtraction of Fractions (ICS)
Multiplication and Division of Fractions (ICS)
Linear Equations (ICS)
Exponents (ICS)
Applied Geometry (ICS)
Practical Trigonometry (ICS)

Second Six Months

Nature of Electricity (ICS)
Circuit Analysis and Ohms Law (ICS)
Capacitors and Inductors (ICS)
Magnetism and Electromagnetism (ICS)
Conductors, Insulators, and Batteries (ICS)
DC Motors and Generator Theory (ICS)
Alternating Current (ICS)
Alternating Current Circuits (ICS)
Inductors in AC Circuits (ICS)
Capacitors in AC Circuits (ICS)
Transformers (ICS)
Alternators (ICS)
Rectification and Basic Electronic Devices (ICS)
Electrical Energy Distribution (ICS)
Introduction to Metering (NUS)
Customer Relations & High Bill Complaints (NUS)

Third Six Months

Register Ratios and Constants
Single Phase Metering I (Northwest Meter School)
Introduction to PC's Series (online)
Installation Checks and Inspections (NUS)
Electrical Measuring Instruments A, B, C (ICS)
Energy Diversion 1 & 2 (NUS)

Fourth Six Months

Using Electrical Test Equipment (NUS)
Reading Electrical Schematic Diagrams (ICS)
Electrical Blueprint Reading (ICS)
Solid State Fundamentals Chapters 1 – 6
Transformers (ICS)
Transformer Operation (ICS)
Instrument Transformers (ICS)

Fifth Six Months

Electric Meters and Associated Devices (NUS)
Polyphase Metering II (Northwest Meter School)
Electric Power Measurements A & B (ICS)
Telemetry (ICS)
Local Distribution of Electrical Power (ICS)
Underground Power Systems (ICS)
Switchgear (ICS)
Electrical Power Substations A & B (ICS)

Sixth Six Months

Intro to Information Systems (TMCC)
Relays I (NUS)
Demand Metering Concepts and Applications (NUS)
Conservation and Load Management
Polyphase System 1 & 2 (NUS)
Polyphase Transformer Rated Applications (NUS)
Polyphase Transformer Rated Meter Testing (NUS)
Principles of Accuracy Testing (NUS)

Seventh Six Months

NEC Articles 90 – 285 (Mike Holt DVDs)
Electronic Metering III (Northwest Electric School)
NEC Articles 250 (Mike Holt DVDs)
NEC Articles 300 – 460 (Mike Holt DVDs)
Demand Metering Concepts (NUS)
Testing and Calibrating Demand Meters (NUS)
“Q” Metering Concepts and Testing (NUS)
Reactive Meter Testing (NUS)
Solid State Meters And Associated Devices (NUS)

Eighth Six Months

Testing Totalizing Techniques (NUS)
Totalizing
Metering Standards
Review

First Six Months:

Month 1:

Meter Safety

Safety in Meter Work

6 hours

NUS Course + Test

This course points out some safety concerns associated with meter work and explains how safety hazards can be minimized. The unit examines single-phase and polyphase self-contained meter installations and points out where high fault current may be present. Also covered are safety practices relating to meter installations or exchanges, personal protective equipment and physical hazards.

Safety in Sub/Switch Yards

6 hours

NUS Course + Test

This unit describes electrical, chemical, and personal hazards that may be encountered, instructs trainees on how to recognize hazards and unsafe practices on the job, and presents a general procedure for responding to imminent dangers and accidents.

Basic Industrial Math Fractions, Percents, Proportions, Angles

5 hours

ICS 186305

The apprentice will understand the terms: fraction, proper fraction, improper fraction, lowest common denominator, percent, ratio, and proportion, how to add, subtract, multiply, and divide fractions and decimals, how to change fractions to decimals and decimals to fractions, how to solve problems involving percent, how to use a protractor to measure angles, how to layout templates for checking angles and how to use a calculator to solve percent problems and to convert fractions to decimals.

Month 2:

Basic Industrial Math (continued) Formulas

5 hours

ICS 186307

At the end of this unit the apprentice will understand the use of letters in formulas, how to prepare and use formulas to solve problems, how to use formulas to calculate the perimeter of a triangle and rectangle, distance, area of a triangle, rectangle, and circle, volume of a pyramid, current in a circuit, and volume of a sphere, how to use a calculator to find square root and solve formulas, how to transform and solve an equation, how to perform basic arithmetic operations with signed terms and how to substitute given numerical values for letters in a formula and find the unknown quantity.

Introduction to Algebra

5 hours

ICS 186308

This unit will teach the apprentice the definition of the terms: term, constant, coefficient, exponent, monomial, trinomial, and polynomial, how to identify and combine like terms in an expression, how to multiply and divide terms containing exponents, how to remove parentheses from an expression and simplify the expression and how to perform basic arithmetic operations with signed terms.

Month 3:

Algebra (continued)

Monomials and Polynomials

6 hours

ICS X0201

This unit will teach the apprentice to remove grouping symbols from algebraic expressions, multiply binomials, and divide on polynomial by another polynomial of lower degree.

Factoring

6 hours

ICS X0202

This unit will teach the apprentice to find the prime factors of certain binomials and trinomials, to factor a given trinomial, to use the Factor Theorem to factor a given polynomial, to use factoring to find the roots of an equation, to divide one polynomial by another polynomial of lower degree and how to find the lowest common multiple of several polynomials.

Month 4:

Algebra (continued)

Addition and Subtraction of Fractions

6 hours

ICS X0203

The apprentice will learn to recognize equivalent algebraic fractions, how to perform additions and subtractions involving algebraic fractions, how to reduce an algebraic fraction to its lowest terms and how to find the least common denominator for a group of algebraic fractions.

Multiplication and Division of Fractions

6 hours

ICS X0204

At the end of this unit the apprentice will be able to perform multiplications and divisions involving algebraic fractions, reduce an algebraic fraction to its lowest terms, find the least common denominator for a group of algebraic fractions, solve equations involving fractions or decimals and simplify complex fractions.

Progress Exam

ICS X0221

Covers courses X0201, X0202, X0203, and X0204.

Month 5:

Algebra (continued)

Linear Equations

6 hours

ICS X0205

In this unit the apprentice will learn to recognize equations expressing mixture problems and other word problems, to solve number problems, digit problems, and age problems and how to recognize the graph of a linear equation, given the graph or a set of points.

Progress Exam

ICS X0222

Covers course X0205.

Excludes courses X0206, X0207, and X0208.

Exponents 6 hours
ICS X0209

At the end of this unit the apprentice will be able to demonstrate an understanding of the meaning of a fractional exponent, apply the rules for positive and negative exponents in multiplication, division, and raising to powers, use radicals to convert fractional exponents and use fractional exponents to convert radicals and write a given number in standard form.

Progress Exam
ICS X0223
Covers course X0209.
Excludes course X0210.

Month 6:

Applied Geometry 6 hours
ICS 186085

At the end of this unit the apprentice will be able to recognize characteristics of angles and closed plane figures, to distinguish between common geometric solids, to apply the Pythagorean Theorem, to calculate perimeters and areas of a polygon, circle, and ellipse and to apply the formula for area and volume of geometric solids.

Practical Trigonometry 6 hours
ICS 186086

This unit will teach the apprentice how to define trigonometric functions, how to use trigonometric tables and apply interpolation, how to solve right triangles and how to apply the laws of sines and cosines in solving oblique triangles.

Progress Exam
ICS X0220
Covers courses 186085 and 186086.

Total Hours First Six Months: 75

Second Six Months

Month 7:

DC Principles
Nature of Electricity 5 hours
ICS 086112

At the end of this unit the apprentice will understand the operation of a simple circuit, the terms: conductor, insulator, and resistor, understand that unlike charges attract and like charges repel, the dangers and benefits of static electricity, the terms volt, ampere, and ohm, common notations and prefixes used to identify electrical and electronic values, carbon resistors, potentiometers, and rheostats, and explain how they work and how to identify the common electrical symbols used in schematic diagrams.

Circuit Analysis and Ohms Law
ICS 086113

5 hours

At the end of this unit the apprentice will understand total resistance in series, parallel, and series-parallel circuits, how to use Ohm's law to calculate the current, voltage, or resistance in circuits and how to calculate the amount of power supplied and dissipated in a DC circuit and the steps for finding current, voltage, and resistance with a digital or analog meter.

Capacitors and Inductors
ICS 086114

5 hours

At the end of this course apprentices will understand how capacitors hold a charge, describe common type of capacitors, calculate total capacitance of circuit containing capacitors in series or parallel, explain how inductors are constructed, describe how inductors regulate the flow of current, and calculate the total inductance of series or parallel connected inductors.

Month 8:

DC Principles (continued)

Magnetism and Electromagnetism
ICS 086115

5 hours

At the end of this unit the apprentice will understand the north and south poles of permanent magnets and electromagnets, magnetic and nonmagnetic materials, how to magnetize a piece of steel by induction, the difference between simple, compound, and closed magnetic circuits, the direction of magnetic lines of force around a conductor (if the direction of current is known), how to use the right-hand rule to locate the poles of a solenoid, the operation of simple electromagnetic relays, buzzers, and stepping switches and how a DC motor operates.

Conductors, Insulators and Batteries
ICS 086116

5 hours

This unit will teach the apprentice the various types of conductors and discuss their conductivity, the American Wire Gage System of sizing copper conductors, the size of conductor needed for an application, the various types of insulating materials and their temperature ratings, the difference between a dry cell and a storage battery, how to connect cells together to obtain more voltage, more current, or more of both voltage and current, the proper safety precautions used when working with storage batteries, how to properly clean and care for storage batteries, and the instruments used for testing storage batteries.

DC Motors and Generator Theory
ICS 086117

5 hours

In this unit the apprentice will learn to identify a series-, shunt-, and compound-wound motor and discuss their application, how a permanent-magnet and stepper motor operate, the steps to reversing a DC motor's direction, how the speed of a DC motor can be controlled, the basic principle for generating a direct current, the factors that affect the strength of the induced voltage, the purpose of a commutator and brush assembly, the difference between the field connections of series-, shunt-, and compound-wound machines, the reason for shifting brushes, the use of commutating poles and compensating windings for better generator operation.

Month 9:

AC Principles

Alternating Current

5 hours

ICS 086118

This unit will teach the apprentice to draw a graph of an AC voltage and describe how AC voltage is created, explains AC cycle terms: "alternation," "peak," "positive," and "negative", the time period of an AC voltage as expressed in degrees, the characteristic values of an AC cycle and describe the relationship between the values, phase angle and describe how it relates to reactive circuits, how to calculate power for single-phase and three-phase circuits, how a 220 VAC single-phase circuit operates, the phase relationship of three-phase wave forms, how to determine real power by reading a power factor meter and delta and wye three-phase circuit connections.

Alternating Current Circuits

5 hours

ICS 086119

At the end of this unit the apprentice will be able to identify electric circuits in terms of their circuit characteristics, list several circuit characteristics that are used to describe a circuit for a particular load application, connect electrical components in series and parallel circuits, control loads from one or two switch points, understand how delta-and wye-connected three phase circuits are different and understand how grounding a circuit increases its safety.

Inductors in AC Circuits

5 hours

ICS 086120

In this unit the apprentice will learn how an inductor is made and how it operates in a DC and AC circuit, inductive reactance and impedance, and how AC frequency affects inductance. How to use Ohm's law in an AC circuit that includes an inductor, how to calculate the impedance of a series RL circuit and how to calculate the impedance of a parallel RL circuit.

Month 10:

AC Principles (continued)

Capacitors in AC Circuits

5 hours

ICS 086121

At the end of this unit the apprentice will understand how a capacitor stores a charge and how series connected and parallel connected capacitance values are calculated, capacitive reactance and using Ohm's Law in AC circuits that contain a capacitor, how to calculate the impedance of a series RC circuit and how changing the frequency of an AC signal changes capacitive reactance.

Transformers

5 hours

ICS 086122

This unit will explain what the main components of a transformer are, how mutual inductance makes it possible to change an AC voltage from one value to another when using a transformer, how to determine the turns ratio of a transformer when the primary and secondary voltages are known, how to calculate primary or secondary voltages or current when either one of these and the turns ratio are known, why transformers are laminated, how to connect three single-phase transformers for three phase operation, how to calculate line current (if phase current is known) in delta-connected transformers and the operating principles of an auto transformer.

Month 11:

AC Principles (continued)

Alternators

5 hours

ICS 086123

At the end of this unit the apprentice will understand how single- and three-phase alternators operate, list and describe the major components of an alternator, discuss alternator ratings in terms of power, voltage, speed and temperature, state the steps required for starting, stopping and operating alternators.

Rectification and Basic Electronic Devices

5 hours

ICS 086125

At the end of this unit the apprentice will understand how diodes are used as rectifiers, the basic operation of a diode and a triode electron tube, how to connect a PN junction for forward and reverse bias, how a transistor operates as an amplifier, recognize transistor input and output circuits, rectifier circuits with and without filter circuits, the operation of an SCR and a triac and how to calculate the ripple frequency of a half-wave and full-wave single-phase and three-phase rectifier.

Electrical Energy Distribution

5 hours

ICS 086124

This unit will explain the difference between feeder and branch circuits, describe the different types of systems available for distributing power within a plant, teach the apprentice to recognize and identify utilization equipment, discuss the use of transformers in energy distribution, identify by name and describe the uses of various types of raceways, teach the apprentice how to distinguish between panel boards and switchboards, describe the electrical system of a power utility and describe how electricity is generated at a power station or utility.

Rectification and Basic Electronic Devices

5 hours

ICS 086125

This unit will explain how diodes are used as rectifiers, discuss the basic operation of a diode and a triode electron tube, how to connect a PN junction for forward and reverse bias, explain how a transistor operates as an amplifier, recognize transistor input and output circuits, compare rectifier circuits with and without filter circuits, describe the operation of an SCR and a triac, and calculate the ripple frequency of a half-wave and full-wave single phase and three-phase rectifier.

Month 12:

Introduction to Metering

6 hours

NUS Course + Test

This unit teaches the apprentice basic concepts of metering by identifying several early types of electro-mechanical watt-hour meters and the basic parts and describe the operating principles of a modern electro-mechanical watt-hour meter. The unit discusses self-contained meter application by explaining the difference between self-contained meters and transformer-rated meters, listing and explaining some of the information typically found on watt-hour meter nameplates and identifying the characteristics of a typical three-phase delta service and a typical three-phase wye service. Transformer-rated meter application is explained by how an instrument transformer is connected to a transformer-rated meter, identifies the two main classifications of instrument transformers and states the function of a test switch. Meter Testing is discussed including the basic steps for conducting a comparison test on a single-phase watt-hour meter, and the function of a standard and describe how a standard is used to conduct accuracy tests. Meterman responsibilities are reviewed with some of the tasks and responsibilities commonly associated with being a meterman, identifying some typical installation checks performed by meterman and explains how they are done, and identifying several forms of power theft.

Customer Relations & High Bill Complaints

6 hours

NUS Course + Test

The apprentice will learn ways in which a meter technician can achieve a proper on-the-job appearance, some of the ways that a meter technician can help ensure a proper level of job preparedness, what job awareness is and why it is important for meter technicians, what is a proper attitude for a meter technician, why it is important to be knowledgeable about the causes of high electrical bills, explain how to use the watt-load check method to determine if a meter reading is accurate, describe a procedure for troubleshooting a high bill complaint at a single-phase residential meter installation.

*Total Hours Second Six Months: 87****Third Six Months*****Month 13:**

Register Ratios and Constants

6 hours

Course + Test

Deals with the many ratios and constants that are essential in interpreting meter reads, setting the pulse output of meters, and determining the pulse value of pulses stored in solid-state recorders or passed on to computerized load management systems. Solid-state meters can display reads in primary terms – determinants of the transformer factors needed by solid-state meters to display reads in primary terms are discussed.

Single Phase Metering - Group I

30 hours

Northwest Electric Meter School (September)

This class is taught off site. The topics covered include: metering math, basic electricity, single phase meter components, meter constants and ratios, loads and meter applications, supplier display, current diversion, instrument transformer basics, phantom load boxes, test jacks and standards, safety, automatic meter reading, single phase meter testing, effects of harmonics on customer equipment, interpreting measurements. This class will involve classroom as well as lab.

Month 14 & 15:

Introduction to PCs Series

35 hours

<http://www.e-learningcenter.com>

This online class is composed of ten lessons. These are as follows: *Introducing the PC*; during this lesson the apprentice will be introduced to basic computer concepts and instructs apprentices on how to start the PC. *Using Your PC* teaches apprentices how to navigate within the windows operating system and use the drives in a PC. *Working with Folders and Files* teaches the apprentices the concepts of folders and files and explains how they are used within the windows operating system. *Inside your PC* explains the components within a PC and how they are used. *Basic Peripherals* describes the function and uses of typical peripherals that are used with PCs. *Other Peripheral* describes the functions and uses of other peripherals available for a PC including modems, sound cards, scanners, digital camera, and external disk drives and explains how to install these peripherals. *Understanding Software* introduces apprentices to typical software available for PCs and how to install and update the software, *Introducing the Internet* introduces apprentices to the internet and explains how to use a Web browser and e-mail. *Troubleshooting and Tips* provides the apprentice with information on how to protect data on their computer and overcome potential problems in addition to offering tips on how to maximize the efficient of their PC.

Month 16:

Installation Checks and Inspections

6 hours

NUS Course + Test

This unit discusses general non-electrical checks and inspections that can be made to a meter installation, non-electrical checks and inspections that can be made inside a transformer cabinet and inside a meter box, how voltage checks may be made on a polyphase, transformer-rated meter installation, how circuit continuity checks may be made on a polyphase, transformer-rated meter installation, how circuit continuity can be checked on a meter installation that has a connected customer load, how a phase check can be performed on a polyphase, transformer-rated meter installation, and how the accuracy and balance of a meter in a polyphase, transformer-rated meter installation can be checked.

Electrical Measuring Instruments

10 hours

ICS 4146 A

The apprentice will learn principles of electrical measurements, instrument movements, measuring current, measuring voltage, measuring power, measuring resistance and frequency and instrument errors and faults.

Month 17:

Electrical Measuring Instruments 10 hours
ICS 4146 B

In the second part of this lesson, the apprentice will learn about bridge measurements; DC bridge measurements; AC bridge measurements; calibration of instruments and telemetering.

Electrical Measuring Instruments 10 hours
ICS 4146 C

In this final section the apprentice will learn about multimeters, volt-ohm multiammeters, vacuum-tube voltmeters, transistor volt-ohm-milliammeters, field effect transistor volt-ohm-milliammeters, digital meters and oscilloscopes.

Month 18:

Energy Diversion 12 hours
NUS 1 & 2 Course + Test

This course will examine some common methods that have been used to divert energy and show how energy diversion can be minimized or prevented. Apprentices first will look at energy diversion on single-phase residential customers and then focus on diversion on polyphase self-contained and instrument-rated installations.

Total Hours Third Six Months: 119

Fourth Six Months**Month 19:**

Using Electrical Test Equipment 6 hours
NUS Course + Test

This unit teaches the purpose and operation of voltage tests, multimeter, clamp-on ammeters, and megohmmeters. The unit demonstrates how electrical test equipment is used to measure current, voltage, and resistance and give appropriate safety precautions.

Reading Electrical Schematic Diagrams 10 hours
ICS 006022

This lesson will teach the apprentice about electrical diagrams; meaning of schematic diagrams; schematic diagrams of basic electric equipment and connections, such as types of circuits; sources of DC power; sources of AC power; transformers; rectifiers; motors; measuring devices; protection and control devices. Also discussed are schematic diagrams of lighting circuits and various types of motor control circuits; typical schematics used in generating systems, transmission systems, and distribution systems.

Month 20:

Electrical Blueprint Reading
ICS 006036

10 hours

In this study unit, the apprentice will learn to read several different types of electrical blueprints. The general principles for preparing blueprints will be covered. The skills the apprentice learns can be applied to reading blueprints for residential, commercial, manufacturing, and electric utility projects. When apprentices complete this study unit they will be able to: explain how blueprints are prepared, discuss how and why blueprints are copies of original drawings, read and understand the information presented on blueprints, be able to identify the different methods of presenting information, understand and interpret common symbols and abbreviations used on electrical blueprints and trace a wiring diagram and understand it.

Month 21:

Solid State Fundamentals
Chapter 1
Chapter 2
Chapter 3

9 hours

Month 22:

Solid State Fundamentals
Course + Test
Chapter 4
Chapter 5
Chapter 6

9 hours

Month 23:

Transformers
ICS 4040

10 hours

In this unit the apprentice will learn essential transformer properties; operation under load and without load; losses; voltage regulation; rating; types of core and windings; insulation; bushings; tap changers; polarity; single-phase and polyphase transformers; delta, star, open-delta, and scott connections; special transformers, autotransformers, reactors, step-voltage regulators; instrument transformers; maintenance of transformers; design of small low-voltage transformers.

Transformer Operation
ICS 4041

10 hours

In this unit the apprentice will learn calculations pertaining to transformer operation; phasor diagrams; equivalent circuits; losses; efficiency; three-phase transformer connections; harmonic currents and voltages; parallel operation of transformers; phase transformation; regulation of voltage with tap changers and separate units; and operation of autotransformers and three-winding transformers; testing of transformers.

Month 24:

Instrument Transformers
ICS 6793

10 hours

In this unit the apprentice will learn fundamentals of current and potential transformers; types of instrument transformers; instrument transformer construction standards, such as ratings and insulation classes; instrument transformer performance standards as to burden, accuracy, and correction factors; practical application of instrument transformers with regard to grounding, rating, connections, and burden; and polarity and accuracy testing of instrument transformers utilizing various methods and procedures.

Total Hours Fourth Six Months: 74

Fifth Six Months**Month 25:**

Electric Meters and Associated Devices
NUS Course + Test

6 hours

This unit examines some of the electronic devices used in or in conjunction with electric metering. These devices are explained and their functions demonstrated.

Polyphase Metering

30 hours

Northwest Meter School Group II (September)

This class is taught offsite. The topics covered include: Operation of three-phase meters, meters in three-phase circuits, graphic and phasor analysis, introduction to three-phase meter, instrument transformer basics, "B" system vector, electronic demand, reactive, KVA metering, system vector, introduction to pulse metering, verification of meter connection, and distribution transformer connections, This class will also have labs covering reactive meters, testing watt-hour meter, and three phase metering.

Month 26:

Electric Power Measurements
ICS 4019 A & B

20 hours

Part 1 discusses: principles of electrical measurements; instrument movements; measuring current; measuring voltage; measuring power, measuring resistance and frequency; and instrument errors and faults.

Part 2 discusses: bridge measurements; DC bridge measurements; AC bridge measurements; calibration of instruments; and telemetering.

Month 27:

Telemetering
ICS 4048

10 hours

This unit discusses: definition and classification of telemetering; analog telemetering systems; frequency telemetering system; impulse duration telemetering system; digital telemetering system; transmission of data signals; telemetering channels; computations in telemetering; telemetering for automatic control; and electric-power-system control.

Month 28:

Local Distribution of Electrical Power
ICS 006038

10 hours

In this study unit, apprentices take a tour of the distribution of electrical energy, starting with the various methods of generation, through transmission systems, into the rural and urban substations, and ending at the customer's service entrance. When apprentices complete this study unit, they will be able to: identify the three classes of power demands and the trends associated with them, identify the various methods used in the production of electricity, understand the generation, transmission, subtransmission, distribution, and secondary voltage levels, understand the conductors used in primary distribution systems, the components used in the protection of primary distribution systems, the clearance requirements associated with secondary distribution, methods of metering consumer usage of electricity, and NEC minimum requirements associated with installing services.

Month 29:

Underground Power Systems
ICS 008639

10 hours

This study unit examines methods and equipment associated with the underground primary transmission and distribution, and the secondary distribution, of electricity to the customer. When apprentices complete this study unit, they will be able to: understand some advantages and disadvantages of underground electrical installations, identify, cables, ducts, enclosures, and equipment used in underground primary systems, understand some of the requirements and methods used in the installation of underground secondary electrical service and understand some of the methods used in the secondary distribution of power in high rise buildings.

Month 30:

Switchgear
ICS 086092

10 hours

In this lesson the apprentice will learn about switchgear and the power system; flow of power; protection of the power system; overlapping protective zones; differential protection schemes; automatic and manual control of generating stations; minimum protection for generators and transformers; protection of distribution systems; circuit breaker ratings and designs; operation of circuit breakers; interruption of AC and DC circuits; AC reclosing service; station-type cubicle switchgear; metal-clad switchgear; low-voltage metal-enclosed switchgear; supervisory and control switchboards; and switchgear devices.

Electric Power Substations
ICS 6590A

10 hours

This unit focuses on the types, purpose, location, and rating of transmission and subtransmission substations, protection of substations, switching systems, switchgear ratings, types of circuit breakers, disconnecting switches, transformation in substations, voltage control in substations, control and operation of substations, and construction of substations.

Electric Power Substations
ICS 6590B

10 hours

This unit focuses on the distribution systems and arrangement of primary and secondary feeders, subtransmission-supply arrangement, high-voltage and low-voltage structures, transformers, voltage-control equipment, metering devices, control instruments, and protective relays, rural substations, industrial substations, direct-current substations, and types of rectifiers used in substations.

Total Hours Fifth Six Months: 116

Sixth Six Months

Month 31:

Intro to Information Systems
IS 101 TMCC

44 hours

This course presents the apprentice an introduction to computer terminology, hardware and application programs for management information systems. Students are introduced to business, industry and education applications of popular software using spreadsheets, word processors, and data bases. "Hands on" experience is provided through student use of open lab

Relays 1

6 hours

NUS Course + Test

This course presents the basic theory of protective relays, a description of commonly used types of relays, and a brief explanation of how these relays are used. Additional details and examples of the applications of directional and non-directional relays are provided.

Demand Metering Concepts and Applications

6 hours

NUS Course + Test

This unit focuses on the need for demand metering and on basic demand metering concepts. Examples of mechanical, thermal, and solid-state types of demand registers are examined and explained.

Month 32:

Conservation and Load Management
SPPC Course + Test

6 hours

Defines what conservation and load management are and the purpose of their implementation. Typical conservation and load management programs briefly describes with special emphasis on how they relate to electric metering. This includes the following:

- a) Time-of-use metering.
- b) Real-time billing and peak indication alarms.
- c) Automated load management systems.
- d) Other conservation programs.

Month 33:

Polyphase Systems 1

6 hours

NUS Course + Test

In this unit the apprentice will learn about polyphase systems, primary and secondary delta connections, primary and secondary wye connections and polyphase banks.

Polyphase Systems 2

6 hours

NUS Course + Test

The second part of this unit discusses when and where various meters should be used. Blondel's theorem will be used to show how a polyphase system is accurately metered. The power measured in both balanced and unbalanced polyphase circuits will be examined.

Month 34:

Polyphase Transformer Rated Application

6 hours

NUS Course + Test

Apprentices examine transformer-rated installations and learn when and why instrument transformers are used. Apprentices also examine transformer basic, polyphase connections, and the most common polyphase transformer-rated installations. Installation procedures are discussed as well as the sizing and proper selection of CTs and VTs.

Month 35:

Polyphase Transformer Rated Meter Testing

6 hours

NUS Course + Test

This unit shows how to test three and four-wire polyphase transformer-rated meters. Close attention will be given to verifying correct disk rotation and matching current and voltage phases before testing. Calibration of typical three and four-wire polyphase transformer-rated meters will be demonstrated.

Month 36:

Principles of Accuracy Testing

6 hours

NUS Course + Test

This unit will present the apprentice with the basic theory of watthour meter accuracy testing. Apprentices will be introduced to typical test equipment and how that test equipment is connected to simulate in-service operating conditions for accuracy testing. In addition, apprentices are shown how to interpret test results. Finally, apprentices are shown test connection diagrams for some typical watthour meters. The areas to be discussed will include principles of meter operation, meter in-service connections, test equipment, test connections and comparisons, and test connection diagrams.

Total Hours Sixth Six Months: 92

Seventh Six Months

Month 37:

NEC Articles 90-285 (excl. 250)

8 hours

General Requirements

Mike Holt DVD Course + Test

The two DVDs cover electrical installations such as splices, terminals, working space, interruption rating, mechanical execution of work access, and guarding. Also the use and identification of the grounded (neutral) conductor and branch circuits, such as current rating, location of receptacles, switches and lights, branch circuits, feeders, outside wiring services, conductor sizing and protection, equipment and disconnecting means, overcurrent protection general rules, location, and enclosures.

Electronic Metering Group III

30 hours

Northwest Electric Metering School (September)

This class is taught off site. The topics covered include: design feature of solid state meters, electronic meter calculations, phasors, field test instruments, computer hardware, primary metering, current diversion, basic programming concepts, testing solid state metering, safety, and installation planning. There will also be labs dealing with phase angle metering and application of electronic metering programs lab.

Month 38:

NEC Article 250

9 hours

Grounding and Bonding

Mike Holt DVD Course + Test

The two DVDs will cover the purpose of grounding vs. circuit grounding, location of grounding connection, and enclosure grounding.

Self-Contained Polyphase Meter Testing

6 hours

NUS Course + Test

This unit demonstrates accuracy tests on a three stator self-contained polyphase meter and a two-and-a-half stator (split element) self-contained polyphase meter in the field. At the end of this unit the apprentice will understand accuracy tests typically performed on a self-contained, polyphase meter, the basic test equipment used for testing a self-contained, polyphase meter, how a self-contained, polyphase meter and the appropriate test equipment are connected to perform each type of accuracy test. The unit also explains basic preparations for testing a polyphase meter, how series element tests may be performed on a three-phase, four-wire, three-stator meter, how individual element tests may be performed on a three-phase, four-wire, three-stator meter, the basic layout of a three-phase, four-wire, two-and-a-half-stator meter (text only), how series element tests may be performed on a three-phase, four-wire, two-and-a-half-stator meter (text only), how individual element tests may be performed on a three-phase, four-wire, two-and-a-half-stator meter (text only). In addition the apprentice will learn preliminary steps that are often taken before adjustments are made to a polyphase meter and how adjustments can be made to a three-phase, four-wire, three-stator meter.

Month 39:

NEC Articles 300-392

8 hours

Wiring Methods

Mike Holt DVD Course + Test

The two DVDs will cover wiring methods, temporary wiring, conductor properties such as circular mils, insulation, ampacity and overcurrent protection, and Articles which contain the specific requirements for the installation of cables. Also covered are raceways, outlet boxes, and other enclosures such as cabinets, cutout boxes, switch-boards, and panelboards.

NEC Articles 400 - 460

3 hours

Equipment for General Use

Mike Holt DVD Course + Test

The DVD explains the general NEC rules that apply to appliances, electric space heating, motors, air-conditioning and transformers such as disconnects, conductor sizing, overcurrent, and overload sizing.

Month 40:

Demand Metering Concepts

6 hours

NUS Course + Test

This unit focuses on the need for demand metering and on basic demand metering concepts. Examples of mechanical, thermal, and solid state types of demand registers are examined and explained.

Testing and Calibrating Demand Meters

6 hours

NUS Course + Test

This unit will demonstrate a method of performing accuracy tests on kilowatt-hour meters equipped with various types of demand registers. Accuracy testing of single-phase and polyphase meters will be shown with emphasis on demand register test procedures.

Month 41:

"Q" Metering Concepts and Testing

6 hours

NUS Course + Test

This unit examines the concepts and theories of Q meters including how they work and how they are tested. Tests are shown in detail including connections and calibration techniques.

Reactive Meter Testing

6 hours

NUS Course + Test

This unit demonstrates accuracy testing on typical three and four wire reactive meter installations. Test procedures for three and four wire reactive meter installations are shown.

Month 42:

Solid State Meters and Associated Devices 6 hours
 NUS Course + Test

This unit examines many of the solid-state devices used in, or in conjunction with, electric metering. The devices are identified and described and their functions demonstrated. In addition, an example of a totally solid-state metering system is presented and its associated components identified.

Total Hours Seventh Six Months: 94

Eighth Six Months**Month 43:**

Testing Totalizing Techniques 6 hours
 NUS Course + Test

This unit examines the principles of operation of four-element and six-element electromechanical totalizing meters. Test equipment connections for accuracy tests on both types of meters and test procedures are covered.

Month 44:

Totalizing 6 hours
 Internally Developed

Describes totalized billing and explains the benefits of its implementation and the class of customers that this billing method applies to. The three most common totalizing methods are described together with the reason for determining which method to select. This class also describes the most common hardware and software used in totalized billing.

Month 45-46:

Metering Standards 30 hours
 Regional Standards – North
 Volume 2

Month 47-48:

Review 32 hours

Total Hours Eighth Six Months: 74

First Six Months**075 hrs**

- Safety 012 hrs
- Algebra 051 hrs
- Geometry 006 hrs
- Trigonometry 006 hrs

Second Six Months**087 hrs**

- Basic Electricity 075 hrs
- Introduction to Metering 006 hrs
- Customer Relations and High Bill 006 hrs

1st Year Total: 162 hours

Third Six Months **119 hrs**

- Single Phase Metering 036 hrs
- Computers 035 hrs
- Installation Checks and Inspections 006 hrs
- Electrical Measuring Instruments 030 hrs
- Energy Diversion 012 hrs

Fourth Six Months **074 hrs**

- Using Electrical Test Equipment 006 hrs
- Reading Electrical Schematic Diagrams 010 hrs
- Reading Electrical Blueprints 010 hrs
- Solid State Fundamentals 018 hrs
- Transformers 010 hrs
- Transformer Operation 010 hrs
- Instrument Transformers 010 hrs

2nd Year Total 193 hours

Fifth Six Months **116 hrs**

- Electrical Meters and Associated Devices 006 hrs
- Poly Phase Metering 030 hrs
- Electric Power Measurements 020 hrs
- Telemetry 010 hrs
- Local Distribution of Electrical Power 010 hrs
- Underground Power Systems 010 hrs
- Switchgear 010 hrs
- Electric Power Substation 020 hrs

Sixth Six Months **092 hrs**

- Introduction to Computer Applications 044 hrs
- Relays I 006 hrs
- Demand Metering Concepts and Applications 006 hrs
- Conservation and Load Management 006 hrs
- Polyphase Systems I & II 012 hrs
- Polyphase Transformer Rated Application 006 hrs
- Polyphase Transformer Rated Meter Testing 006 hrs
- Principles of Accuracy Testing 006 hrs

3rd Year Total 208 hours

Seventh Six Months**094 hrs**

- NEC Articles 90 – 460 028 hrs
- Electronic Metering 030 hrs
- Self-Contained Polyphase Meter Testing 006 hrs
- Demand Metering Concepts 006 hrs
- Testing and Calibrating Demand Meters 006 hrs
- "Q" Metering Concepts and Testing 006 hrs
- Reactive Meter Testing 006 hrs
- Solid State Meters Associated Devices 006 hrs

Eighth Six Months**074 hrs**

- Testing Totalizing Techniques 006 hrs
- Totalizing 006 hrs
- Metering Standards 030 hrs
- Review 032 hrs

4th Year Total 168 hours

Approximate Total Program Hours 731 hours

Subsequent edition/volume changes of textbooks are approved for use through the discretion of the program.

Wages

Wage Schedule for Apprentice Meter Technician – See Collective Bargaining Agreement, but should be reflected of prorated portions of the Journeyman Wage. The current wage scale (on the check) outlined in the Collective Bargaining Agreement