

NECE APPRENTICESHIP COURSE DESCRIPTIONS

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APP 100 - Introduction to the Electrical Industry and Power Grid

This course will begin with a basic introduction to the systems and components that make up a basic electrical system, including generation, transmission and distribution. Students then study the history behind electrical utility industry, how the electrical system in the United States was established and how Thomas Edison and George Westinghouse influenced the development of electrical systems. They learn how the electrical industry was first regulated and how regulation of the industry has changed. Students learn how the electrical industry is currently being re-regulated to encourage competition. Students will also gain knowledge of the system operations and marketing of electricity. Finally, they study how the electrical industry is segmented into utility sectors, such as investor-owned, federally owned, publicly owned and cooperatively owned utilities.

APP 106 - Basic Electricity I

This course covers basic direct current theory and application. Students will study methods of producing direct current voltage, including batteries, and magnetic fields. Students will learn to calculate voltage, current, resistance, and power in series, parallel, and combination DC circuits. The construction and operation of rotating DC machines including DC generators and DC motors will also be covered.

APP 108 – Basic Electricity 2

This course covers basic alternating current theories and applies those theories to electrical systems and related equipment. Students will also study basic generator and motor design, construction and operating principles.

APP 111 – Math I

This course will teach basic math skills and apply those to energy industry situations. Students will learn the metric system, basic volume and area calculations as well as algebra and trigonometry and how they apply to industry specific situations.

APP 112 -- Math II

This course covers algebra, geometry and trigonometry needed for energy technicians working in the electrical system design and metering specialization areas. The course covers the fundamental concepts of algebra, equations, functions and graphs. The course also covers trigonometric functions, laws of sines and cosines, vectors and analytic geometry.

APP 114 -- Industrial Safety & Health

This course provides standard safety, health and environmental practices performed in the electrical industry. Students study safe work practices, including personal protective equipment, chemical safety, fire protection, and tool and machine safety. Students will then learn about electrical safety and protection. Throughout the course, personal responsibility required for safe and environmentally sound work habits will be reinforced.

APP 119-- Troubleshooting and Emergency Repair of DC/AC Systems and Equipment

This course provides an overview of AC and DC power systems, with an emphasis on grounding methods and techniques for identifying open and short circuits. Students will learn how to troubleshoot and repair AC and DC systems, including addressing grounding issues, opens, and shorts. The course also explores the role and importance of these power systems within the electrical power industry.

APP 120-- Industrial Prints and Diagrams

This course introduces students to the different schematics used in power plant operations and electrical transmission and distribution systems. Students will gain an understanding of the standard symbols and how to read them. Students learn how to read basic piping and instrumentation diagrams, how to interpret single line electrical diagrams and how to navigate complex electrical systems and feeder maps. Students also study schematics that are used when working with electronic systems and system instrumentation that is used to control and monitor the flow of electricity through the electrical system. Throughout the course, students will learn to use the diagrams to troubleshoot system problems and safely isolate sections of the electrical system.

APP 122-- Electrical System Components

This course provides in-depth look into the components used in the transmission of electricity. Students begin with an introduction to the generation of electric power. Students will then learn how switchyards, substations, overhead transmission systems, and underground transmission systems transmit that power at the proper voltage levels and provide system protection. Components such as transformers, circuit breakers, regulators, capacitor banks, tap changers, disconnects, current and potential transformers, relays, and lightning arrestors will be examined in detail. Students will also study the various types of electrical conductors, structures, and insulators used to transmit electricity.

APP 137--Power Quality

This course is designed to provide a brief overview of the subject of Power Quality. The student should come away with a limited understanding of some of the sources and issues related to power quality.

APP 152--Safety in Substations and Switchyards

This course will cover the safe operating practices, system isolation procedures, and accident prevention procedures used in the transmission and distribution of power. Emphasis will be placed on electrical system lock out and safety procedures.

APP 153--Transformer Maintenance

This course begins by reviewing basic transformer design and operation. The course also covers 3-phase transformers, single-phase loads for 3-phase transformers, and the connections used in such transformers. The course introduces students to installation procedures and maintenance procedures.

APP 160--Introduction to Transmission and Distribution Systems

This course will discuss the basic electrical power grid system from the electrical generation facility to your home usage. Students will study the different types of electrical power production including fossil fired, hydroelectric, gas turbine, combine cycle, nuclear power and renewable energy sources such as wind, solar, and geothermal. The course will also cover what the future of the electrical system might look like using fuel cells and smart grid technology.

APP 161--Electrical System Protection

This course covers philosophies and principles used to protect the electrical system from abnormal and fault conditions, beginning with the generator. Instrument transformers, protective relays, and system grounding principles are covered.

APP 163 - Power Flow

In this course, students study the control of power flow through interconnected systems and the operation of parallel power systems. The topics include generator synchronization, phase angles, VAR control and line voltage regulation. Procedures for controlling electrical power flows to maintain steady state conditions across the power grid are also a focus of this course.

APP 164 - Control Equipment, Substation and Switchyards

This course will detail the specifics of power electronics as applied in substations for power transmission. It will describe typical functions provided in utility substation automation systems and some important considerations in the interface between substation equipment and the automation system components. Students will look at the availability of information, the analysis of this information, and the subsequent decision making to optimize system operation in a competitive environment. Oil containment, animal issues and security will also be discussed and the requirements necessary to qualify a substation to withstand seismic events. The operation of substation fire protection and substation communications systems such as the SCADA system and SCADA security will be examined.

APP 165 - Using Line Test Equipment

This course will identify types of line test equipment commonly used in the field, demonstrate how to use ammeters, voltmeters, and voltage testers and describe the types of readings expected from ammeters, voltmeters, and voltage testers.

APP 167 - DC Power Systems

This course will begin with discussing types, efficiency and advantages and disadvantages of batteries and chargers. Next the students will learn and describe the parts, properties and advantages of transformers. The course then covers positive ground and the importance of good grounding. DC power systems troubleshooting practices, testing procedures and specifications are also covered.

APP 170 - Relays I and II

This course focuses on testing and calibrating substation equipment, including voltage testing on equipment feeder relays, and circuit breaker relays. Students also learn the various tests that need to be conducted on protective relays, such as overcurrent and voltage relays, directional and line relays, as well as ground and test device testing.

APP 171 - Capacitors and Reactors

This course will describe the basic principles involved in operating and maintaining capacitors and reactors. The course explains the effect that capacitors and reactors have on power factor and explains how and why capacitors and reactors are used. Demonstrations of inspection and maintenance of both capacitors and reactors are shown.

APP 175 - Current Transformers

This course will cover the functions of a current transformer, describe common current transformer applications in a substation and describe the construction of common substation current transformers. The course also covers the steps for demagnetizing a current transformer, complete ratio testing and describe the voltage method of checking the full winding ratio and tapped winding ratios of a current transformer.

APP 180 - Introduction to Metering

This course introduces students to the fundamentals of metering, such as terminology and basic principles of meters. Students learn basic math needed in metering and review basic electricity and magnetism principles. They are introduced to meter testing equipment, meter diagrams and standards, and learn technical data and how to read watt hour and demand meters.

APP 181 - Instrument Transformers and Polyphase Metering 1 and 2

In this course students learn about single-phase metering and polyphase metering, including meter design, adjustments and compensations, and applications. They also learn about power factor analyzers, high amperage CT cabinets, meter demand theory, demand registers, and testing and maintenance of thermal demands.

APP 182 - Watthour Meter Principles

This course introduces students to various metering system designs and application options. The students study the metering system components, associated wiring configurations and instrument transformer

variations. Topics include ratio, burden, correction factor calculations, functional testing, and calibration procedures as well as safe installation procedures. Also included are cogeneration metering, and principles of load management

APP 190 - Operator Fundamentals of GIS and GPS

This course will cover the roles that the Global Positioning System and Geographic Information Systems play in modern water utilities. Students will learn the definitions of GPS and GIS, the difference between the two, and the benefits of these technologies to their utilities. Topics covered will include mapping utility assets, using GIS and mobile devices in everyday tasks, and asset management using GPS and GIS.

APP 204 - Advanced Electrical System

This course provides students with a complete understanding of the design and operation of electrical transmission and distribution systems. Students begin by studying the basic principles of transmission and distribution circuits, including the advantages and disadvantages of AC and DC transmission. Students will also learn some of the procedures used by system operators and line crews to maintain the safe and effective delivery of power during adverse conditions and the steps necessary to restore power after outages. An introduction to distribution system automation is also provided.

APP 210 - Overhead Transmission & Distribution Line Construction

This course covers the design and construction of transmission and distribution overhead lines. This includes structures, conductors, insulators and the factors that influence particular use for both transmission and distribution systems. The course covers guidelines for working safely with poles, conductors, switchgear, transformers, rigging, grounds and more. Students will be introduced to high and low voltage troubleshooting procedures, stringing procedures and guidelines for live line work. Maintaining good voltage to the customer and street lighting issues also will be discussed.

APP 230 - Underground Line Construction

This course covers the two basic categories of underground line construction, such as direct burial and those found in vaults and ducts. Students learn the design, conductors and the transformers used in residential direct burial and the factors that affect it. The course includes underground line construction design and the factors that affect this type of installation

APP 232 - Electrical System Design

In this course, students will be introduced to the basic components and operations of electric utility distribution substations and circuit feeders. Their functions, typical design parameters and the coordination of their protective devices are presented to form a complete picture of the working systems they comprise. Topics include transformers, bus configurations, regulators, capacitors, circuit breakers, reclosers, relays, fusing, arresters, reliability, power

APP 240 - Power Industry Concepts

This course covers the basic role system operators and electrical dispatchers play in the electric power industry. In addition, students will study the history, development and evolution of the electric industry since inception. This course also explores the effects of deregulation of modern day electrical markets. This course concludes with the working environment of system operators, including some of the challenges they face, such as shift work, certification and the tremendous amount of responsibility operating in a real time

APP 250 - Electrical Generation Theory

Students will learn the design and construction of large electrical generators. Students will study the sources of voltage and the design and types of A.C. and D.C. generators and related auxiliary equipment. Students will also study the design and operation of A.C. and D.C. motors.

APP 251 - Substation Construction & Maintenance

This course begins with a review of hand and power tools used during the construction and maintenance of substations and continues with safety procedures and equipment put in place to protect workers within a substation. Students learn the basic construction of a substation, including electrical equipment rigging and installation, cable tray and conduit

APP 252 - Civil Design

In this course students study the basic principles of civil design in electrical distribution system facilities. It includes site selection and surveying, soils testing and compaction, grounding, grading, drainage and oil catchment requirements, step potential protection, design layouts, line plan and profile development, foundations, trenching and raceway design, and underground distribution cable direct burial, duct bank, manhole and vault

APP 254 -System Elements I - Substations

This course is designed to cover the basic equipment found in switchyards and substations. Also included are the functions and types of substations, related transmission and distribution systems, and how each system is tied to one another.

APP 256- System Elements II - Transformers

This course furthers a students understanding by introducing basic diagrams, transformers, and basic substation safety and performing inspection. Topics covered in this course will include interpreting one-line diagrams, exploring power and specialty transformers, and lock-out/tag-out (LOTO) procedures for transformers. This course will also introduce power transformers and the role they play in the overall electrical system, including switchyards, substations, and distribution networks. In addition, the study of basic switching procedures and the role and responsibilities of lineworkers, switchmen, system operators and dispatchers in these procedures will be a focus.

APP 258 - System Elements III - Protective Relaying

This course focuses on protective relaying of substation equipment and transmission lines. Details found in this course include practical understanding and identification of protective and control equipment, zones of protection, protection schemes, and relay communication systems.

APP 260 - Electrical Diagram Interpretation

This course covers electrical diagrams including single line diagrams, schematic diagrams and logic diagrams. This course focuses on the system operators perspective and the role diagram comprehension plays in an operators job performance.

APP 262 - Power System Operations

This course covers the basic roles and responsibilities of system operators including transmission operations, market operations, reliability, balance and interchange and scheduling. The goal of this course is to introduce the multitude of positions found in a typical transmission control center.

APP 266 - Interconnected System Operations

This course covers the operation of power pools, regional reliability organizations and independent system operators and the role of each. In addition, this course covers interconnected switching procedures between utilities.

APP 270 - System Operator Work Practices

In this course students will learn the role a system operator plays in the delivery of power and the operation and maintenance of the transmission system. Students will learn what is expected of a system operator including desired personal characteristics, working environment, employer's expectations/qualifications, educational and training requirements, certification requirements, role in performing reliability functions, tasks and duties and behavior required under code of conduct and other regulatory and legislative orders.

APP 272 - Power System Safety

This course will cover the safe operating practices, system isolation procedures, and accident prevention procedures used in the transmission and distribution of power. Emphasis will be placed on electrical system lock out and safety procedure.

APP 274 - Communication & Control Technology

This course covers the theory and application of various communications technologies used in the electric industry.

APP 276 - Power System Economics

This course covers economic factors governing electrical system operations. Costs of generation, transmission and distribution are explained. The organization of markets for electrical energy and how this structure affects participating companies' operational and investment decisions are discussed. The effects of congestion, transmission losses and penalty factors are studied. Load management, scheduling and pricing are a focus as well.

APP 278 - Power System Emergency Concepts

This course is designed to concentrate on recognition of and reaction to power system emergencies, and the implementation and coordination of proper procedures to restore the electrical system to a safe operating condition. Learners will study substation bus configurations and the protection schemes used to respond to emergencies within the electrical system. Effective and safe restoration of system operation through proper

APP 280 - Reliability Policies & Procedures

This course familiarizes and helps students understand the policies and procedures that ensure the reliability of the power system. North American Electric Reliability Corporation (NERC) standards, as well as other regulatory agency policies, are explained and discussed. Government agencies, reliability regions, and state reliability concerns also are defined and discussed

MMAT 105 - Hand & Portable Tools

This course covers the most important hand tools used on the job. Examines the various kinds of wrenches and screwdrivers, their uses and handling techniques, pipefitting tools, plumbing tools, electrician's tools, sheet metalworking tools, machinists' metal-working tools.

MMAT 109 - Measurements

This course covers units of measurement used in commercial and industrial applications. Examines all aspects of basic measurement concepts and procedures, including accuracy and tolerance. Covers techniques and devices for comparison measurements (dial indicators and gauge blocks).

MMAT 111 - Schematics, Symbols & Blueprints

Covers all types of schematics and symbols used in commercial and industrial settings. Examines symbols on schematics, electrical symbols and diagrams, piping symbols and diagrams, hydraulic and pneumatic diagrams and symbols. Studies and explanations of electrical/electronic control schematics. Covers welding and joining symbols.

MMAT 113 - Industrial Rigging

This course covers techniques and safeguards in the use of rope, chain, hoists, and scaffolding when moving heavy plant equipment and maintaining plant utilities. Also covered in the the course are ladders, scaffolding and precautions required for walking and working on various surface in an Energy facility

MMAT 115 - Lubrication, Bearings & Seals

Covers a complete lubrication training program, including functions and characteristics of lubricants, factors in selection of lubricants, and effects of additives. Oils, greases, and other compounds used for lubrication are described, as well as their applications. Covers plain bearings, their parts, dimensions, functions, and relining techniques. Continues with installation and replacement of antifriction bearings. Also covers linear motion bearings and shaft seals.

MMAT 117 - Material Handling Systems

Covers belt conveyors that carry coal, sand, gravel, grain and other loose materials. Acquaints the student with the terminology, basic structure, and operation of material handling systems. Includes detailed coverage of belts, belt cleaners, idlers, and feed/discharge devices, as well as an explanation of how to install, maintain, replace, and troubleshoot these components

MMAT 119 - Troubleshooting Skills

Explores the subject of troubleshooting and the importance of proper maintenance procedures. Covers working with others, aids in communication, and trade responsibilities. Outlines troubleshooting techniques and aids, using schematics and symbols. Focuses on specific maintenance tasks, breakdown maintenance, and planned maintenance.

MMAT 150 - Mechanical & Fluid Drive Systems

Covers belt drives, chain drives, gears and gear drives, adjustable-speed drives, shaft alignment, shaft coupling devices, and clutches and brakes.

MMAT 155 - Hydraulics & Pneumatics

Covers hydraulic and pneumatic principles, types of hydraulic fluids and their characteristics. Describes components of hydraulic and pneumatic systems and their functions, including filters and strainers, reservoirs and accumulators, pumps, piping, tubing and hoses, control valves, relief valves and actuating devices.

MMAT 160 - Valves & Steam Traps

Covers maintenance and operation of gate, globe, ball, plug, check, special-purpose valves and steam traps. Details actuators and various accessories. Explains valve selection based on application. Explores methods of protecting piping systems.

MMAT 162 - Piping & Tubing Systems

Covers tubing specifications, materials, and fittings. Explores procedures used for handling, bending, cutting and installing tubing. Gives basics of tubing in

a hydraulic system. Covers hose systems, gaskets, sealant, and adhesives. Covers piping and tubing systems used for fluid transport in the plant: Hydraulic fluids, steam, liquefied product, refrigerant, and water. Explores typical metallic and nonmetallic piping systems, pipe-joining methods, and how tubing and hoses differ from piping, valves, pipe fittings, hangers, supports and insulation and covers how tubing is sized, fitted, bent and joined. Studies uses of traps, filters, and strainers.

MMAT 170 - Equipment Installation

Covers installation procedures for large plant equipment. Considers factors affecting proper installation in detail, from preparatory relocation of underground piping and wiring, through equipment anchoring, aligning and test running.

MMAT 175 - Pumps, Compressors & Turbines

Covers typical applications of various types of pumps, compressors and turbines. Explores factors affecting equipment selection. Defines operating principles of centrifugal, propeller, and turbine, rotary, reciprocating, and metering equipment. Includes special-purpose pumps, diaphragm pumps, and others designed to handle corrosive and abrasive substances.

MMAT 205 - Basic Electricity and Electronics

Covers basic, nonmathematical approach to understanding principles of electricity. Introduces electron theory, static electricity, electrons in motion, and magnetism. Covers basic methods of measuring current, voltage, and resistance. Explains circuit components-conductors, insulators, resistors, capacitors-and simple Ohm's Law calculations for DC and AC circuits.

TELEC 101 - Microwave Fundamentals

This course is designed to provide the participant with an understanding of the theoretical and practical fundamentals of microwave behavior and system structure. Some of the concepts the students should understand when completed with this course are the operating characteristics and theory of antennas,

space diversity, signal propagation, fade margin and the transmission of a microwave signal in what is referred to a point to point communications. Other topic such as modulation rates and spread spectrum methods, repeaters, receiver performance tests and hot standby are covered.

TELEC 102 - Digital Hierarchy

In this course you will cover the basics of the Digital Transmission System including the following areas: DS0, DS1/T1, DS3, OC3-OC196.

TELEC 103 - Multiplex Equipment

This course is designed to give you an introduction to multiplexers and to describe some of the common input/output devices that are connected to them. We use the T1 system to demonstrate some of the features of a time division multiplexing system. While discussing the T1 system we will describe the methods of encoding data, error checking of data and the alarm system that T1 uses to give you an indication of its operating status.

TELEC 104 - Fiber Optics

This course is designed to give you a basic understanding of how fiber optics work, how they are installed and some of the basic test equipment used to test and install fiber optic cable.

TELEC 120 - Antenna Systems

This course is intended to provide the student with the theory of operation and applications of antennas as found in the communications industry. Some of the topics covered are basic antenna operation and characteristics, antenna configurations, radiation resistance, gain, directivity, beam-width, front to back ratio, impedance and polarization just to mention some of the topics covered. Where appropriate, theory is reinforced with problem solving to support the concepts at hand.

TELEC 121 - Filter Systems

This course is an introduction to transmitters, receivers, and radio waves. It will cover the key elements in transmitter/receiver systems specifically

antennas, filters, and power amplifiers. Next students will study test equipment used in testing of transmission systems and their components. Lastly, the course will focus on specific test procedure and most important tests of these systems

TELEC 122 - Grounding Systems

This course is designed to give students an introduction to grounding systems while doing it safely. Covered in this course is grounding for DC 48v systems, AC grounding, tower and site grounding, single point grounding, and soil resistivity testing as well as lightning protection. The course is based on current National Electrical Safety Code

TELEC 123 - GPS

This course is intended to introduce students to Global Positioning Systems (GPS). GPS is used to determine our location, to help us navigate between locations, to track the movement of people and things, to create maps, and to provide precise timing.

TELEC 132 - Key Systems

This course is a basic introduction and history to key systems. Key systems are primarily defined by their individual line selection buttons for each connected phone line, a feature shared with hybrid systems.

TELEC 133 - Ethernet

This course also covers basic routing and many other networking devices; it is designed to give you a "basic" understanding of how the entire network works.

TELEC 135 - PBX & VOIP

In this course we will take a look at the basics of each system and how they came to be, keeping in mind that as time marches on, VoIP will most likely become more dominate and wide spread with PBX morphing into a combination of traditional and IP configurations.

TELEC 140 - SCADA

This course is intended to introduce students to SCADA (Supervisory Control and Data Acquisition) and the processes involved in gathering information from remote locations and using that information to build historical data, monitor and control systems in various industries.

TELEC 141 - Basic Networks & SNMP

This course will cover the basics of SNMP (Simple Network Management Protocol). We will start with the basics of SNMP and how it works, covering technical elements such as OIDs, MIBs, community strings, and traps. Students will also how to use SNMP to keep track of what your network is doing. The course will focus on practical system and network administration, how to configure SNMP agents and network management stations.

TELEC 142 - Microsoft Visio

This course teaches the basic functions and features of Visio 2016. As part of this course you will learn about several types of diagrams and flowcharts. The second book helps you move into advanced plan and diagrams and improving the looks of those. Lastly you will learn to use external tools, and sharing your drawings.

TPC 102 - Reading Schematics and Symbols

Covers all types of schematics and symbols used in commercial and industrial settings. Examines symbols on schematics, electrical symbols and diagrams, piping symbols and diagrams, hydraulic and pneumatic diagrams and symbols. Discusses air conditioning and refrigeration systems, including explanations of electrical/electronic control schematics. Covers welding and joining symbols

TPC 105 - Metals in the Plant (or Metallurgy Equivalent)

Introduces metals, metallurgy, and metalworking. Discusses the properties of metals, including their mechanical properties. Examines several industrial manufacturing processes. Covers iron and standard steels. Explains the different kinds of heat treatment

and their usage. Discusses some techniques of working with copper, aluminum, magnesium, titanium, lead nickel tin and zinc

TPC 106 - Nonmetals in the Plant (or Metallurgy Equivalent)

Introduces major nonmetal materials and how they are most frequently used. Describes properties, characteristics, and classifications of each material. Covers synthetic and natural materials. Examines various paints and coatings, their proper use, preparation, and application. Surveys industrial chemicals. Chemical safety precautions are covered, along with the proper use of protective equipment.

TPC 110 - Developing Troubleshooting Skills

Explores the subject of troubleshooting and the importance of proper maintenance procedures. Covers working with others, aids in communication, and trade responsibilities. Outlines troubleshooting techniques and aids, using schematics and symbols. Focuses on specific maintenance tasks, breakdown maintenance, and planned maintenance.

TPC 114 - Waste-to-Energy Fundamentals

Covers fundamentals of waste combustion-characteristics and handling of MSW fuel, furnace designs, waste combustion, and plant operations.

TPC 202 - Batteries and DC Circuits

Covers how electrochemical action is used. Covers batteries, electrolytic action, electroplating, Characteristics of storage batteries, application and maintenance of lead-acid, nickel-alkaline, and nickel-cadmium batteries, putting batteries into service, charging batteries, maintaining records, fundamentals of DC circuits, and using Ohm's Law to solve problems in DC series, parallel, and series-parallel circuits.

TPC 203 - Transformers and AC Circuits

Covers differences between DC and AC circuits. Explains AC sine wave, using vectors to solve AC problems, calculating impedance in circuits having inductance, capacitance, and resistance, AC power

relationships in single-phase and three-phase circuits, and principles of transformer maintenance.

TPC 204.1 - Electrical Measuring Instruments

Covers the principles on which electrical test instruments operate. Basic instruments covered include voltmeter, ammeter, wattmeter, ohmmeter, and megohmmeter. Covers AC metering, split-core ammeter, use of current and potential transformers. Includes detailed coverage of modern multimeters. Explains functions and uses of oscilloscopes.

TPC 205.1 - Electrical Safety & Protection

Examines electrical hazards and stresses the importance of electrical safety. Covers the equipment and procedures necessary to work safely with electricity, including PPE, lockout/tagout, and first aid. Explains the importance of grounding. Describes many kinds of fuses, circuit breakers, and motor protection devices and their uses.

TPC 206 - DC Equipment and Controls

Covers DC power applications in industry, types of DC generators, operating characteristics of DC motors, DC armature principles, and armature maintenance and repair. Includes types of DC relays, DC controllers, overspeed and overload protection, drum and reversing controllers, dynamic braking, DC power supplies, diodes, semiconductors, SCR principles, and DC maintenance practices.

TPC 207 - Operating and Maintaining Single-Phase Motors

Covers the types and operating principles of common single-phase motors. Explains NEMA motor standards. Explains how to identify motor leads on split-phase, capacitor-start, capacitor-run, permanent split capacitor, and repulsion motors. Also covers universal motors, shaded-pole motors, and other special types, including synchro and servo systems. Gives general maintenance procedures on all single-phase motors.

TPC 208 - Operating and Maintaining Three-Phase Systems

Covers three-phase motor principles for induction, synchronous, and multi-speed dual-voltage motors. Gives recommended maintenance practices for large AC motors. Covers principles of three-phase motor starters, part winding, reversing, jogging, alternator principles and operation. Describes three-phase power distribution.

TPC 209 - Understanding Basic AC Control Equipment

Covers the broad range of industrial motor starting and control equipment, including NEMA sizes and ratings. Includes pushbutton control stations, limit switches, mercury switches, mechanical and magnetic plugging, foot switches, and pressure, temperature, and float switches. Covers control panel wiring and special applications.

TPC 210 - Developing Electrical Troubleshooting Skills

Covers use of schematic diagrams, determining sequence of operation, and use of building diagrams and single-line diagrams. Includes troubleshooting procedures for control circuits and combination starters. Explains troubleshooting practices on DC and AC motors, identifying unmarked leads on three-phase delta and Y-connected motors, and troubleshooting lighting systems.

TPC 251 - Semiconductors

Covers the theory behind semiconductor operation. Describes the characteristics and operation of various diodes and transistors. Stresses the importance of proper environmental conditions and explains how to minimize electrostatic discharge (ESD) and radio frequency interference (RFI). Discusses printed circuit board (PCB) and integrated circuit (IC) technology, including connection and replacement methods. Identifies kinds of semiconductor packages. Explains how to interpret manufacturers' spec sheets and how to analyze circuit performance by Q points and characteristics.

TPC 252 - Power Supplies

Covers the four basic kinds of power supply conversions. Explains how to work with nonchemical cells as well as primary and secondary cells of various materials. Describes in detail the functions and operation of several kinds of rectifiers, filters, and voltage regulators and explains how they work together as power conditioners. Discusses basic tools, test devices, and procedures for troubleshooting to solve the greatest number of problems in the least amount of time.

TPC 253 - Amplifiers

Covers the effects of gain, bandwidth, and distortion on amplifier performance. Compares linear and nonlinear (switching) amplifiers. Explains how to use transistor curves to analyze amplifier operation in terms of operating regions, load lines, operating (Q) points, and biasing. Discusses impedance matching and compares capacitive, transformer, and direct-coupled amplifiers. Describes many ways op amps are used today, including integrators and comparators. Provides specific methods for troubleshooting common amplifier problems.

TPC 254 - Oscillators

Covers how oscillation is started and maintained. Compares LC (tuned), RC (phase-shift), and crystal oscillators. Compares sine-wave oscillators and square-wave switching circuits. Discusses monostable, astable, and bistable flip-flop operation in detail and shows expected waveforms. Explains how logic clocks are generated and conditioned. Discusses Schmitt trigger circuits, frequency dividers, and ripple counters, as well as propagation delays and glitches. Describes the operation of low-pass, high-pass, band-pass, and band-reject filters, including differentiators and integrators. Describes the equipment and procedures for troubleshooting oscillator components and circuits.

TPC 261 - Introduction to Computers

Covers a brief history of the computer and defines fundamental computer terms. Introduces the binary and hexadecimal number systems. Explains the

different levels of programming languages. Describes microprocessor characteristics and architecture in general terms. Concludes with examples of practical applications.

TPC 262 - Input-Output Devices I

Covers many of the input/output devices that make up a typical computer system. Explores communication-the successful transmission of information between computers-at length. Discusses both the user/machine interface and the machine/machine interface, as well as the various network configurations. Concludes with two "real-world" examples of how microprocessors are connected to I/O devices.

TPC 266 - How Computers Function

Covers the function and basic operation of each major element of a microprocessor. Explains the structure and purpose of various computer buses. Examines characteristics of different types of main memory in detail. Includes in-depth discussion of both low- and high-level computer languages.

TPC 267 - Input-Output Devices II

Covers more fully many of the input/output devices introduced in Course 262. Describes various magnetic and optical memory devices, including tapes, disks (hard and floppy), and CD-ROMs. Explains how signals are converted from analog form to digital form, and vice versa. Covers data acquisition systems and common digital transmission standards. Defines the error detection techniques used to ensure the accurate transmission of digital data. Describes various types of digital transmission equipment, such as modems and fiber optics.

TPC 268 - Maintaining/Troubleshooting Computer Systems

Covers the maintenance of microprocessor-based equipment, including preventive maintenance. Describes diagnostic procedures and takes a "hands-on" look at many types of test equipment, including oscilloscopes, logic analyzers, and in-circuit

emulators. Emphasizes the importance of thorough documentation in all areas. Discusses general troubleshooting guidelines and covers troubleshooting aids and accessories.

TPC 271 - Introduction to Process Control

Covers the function of basic devices for measuring and controlling different kinds of variables in process control. Introduces closed-loop control and PID functions. Introduces analog and digital devices and programmable logic controllers (PLCs). ISA and SAMA instrumentation symbols and interpretation and use of process diagrams are covered.

TPC 273 - Pressure Measurement

Covers units of pressure and discusses Boyle's and Charles' laws to explain relationships among pressure, volume, and temperature. Describes sensor operation of manometers, bourdon tubes, diaphragms, and bellows. Explains the operation of potentiometric, capacitive, reductive, servo, strain-gauge, and piezoelectric transducers. Describes devices used in low-pressure control. Discusses proper and safe methods for installing and servicing

TPC 274 - Force, Weight & Motion Measurement

Covers force, stress, and strain and explains the operation of strain-gauge systems. Relates weight to mass and scales to balances. Explains the operation of load-cell scales. Describes belt-scale, nuclear-scale, and weigh feeder operation. Covers position measurements by means of proximity detection, air gauging, LVDT gauges, synchros, code disks, and other devices. Explains machine tool control and accelerometer operation. Describes the

TPC 275 - Flow Measurement

Covers principles of fluid flow and how primary devices affect fluid flow. Describes flow measurement using several kinds of secondary devices. Discusses rotameters and other variable-area instruments. Explains how weirs, flumes, and other arrangements measure open-channel flow. Compares many kinds of positive-displacement meters and explains the operation of several kinds of turbine and magnetic

flowmeters. Describes less-common flowmeters (including vortex-precession, mass flow, and ultrasonic devices) and instruments that meter the flow of solids. Provides guidelines for safe installation and maintenance of flow devices.

TPC 276 - Level Measurement

Covers principles governing various methods of measuring level. Explains operation of conductive, capacitive, resistive, ultrasonic, and photoelectric devices. Compares the operation of several kinds of pressure-head instruments. Explains the measurement of solids by ultrasonic, microwave, radiation, and other methods. Discusses several special-application devices for both continuous and point level measurement.

TPC 277 - Temperature Measurement

Covers units in thermal measurement and operation of RTDs (and wheatstone bridges), thermistors, and thermocouples and thermometers. Includes principles of pyrometry and operation of narrowband, broadband, and bandpass pyrometers. Discusses calibration standards, typical calibrating methods, and instrument testing.

TPC 278 - Analytical Instrumentation

Covers principles, installation, calibration, and maintenance of conductivity probes, and methods of stack gas monitoring. Includes how to install, calibrate, and maintain pH and ORP measurement instruments and operation, installation, calibration, and maintenance of several optical analyzers. Discusses principles and safe practices governing sensors used in measuring oxygen, carbon monoxide, carbon dioxide, and other products of combustion. Concludes with operation, calibration, and system components in liquid and gas

TPC 279 - Final Control Elements

Covers how elements in a closed-loop system affect final control element. Describes components in final control subsystems. Discusses operations of solenoids, motors, relay systems, and PLCs. Explains pneumatic actuators and positioners. Describes

mechanical advantage in several hydraulic control systems. Compares construction, characteristics, and applications of eight control valves. Traces operation of each element in typical feedwater,

TPC 280 - Safety, Calibration and Testing Procedures

Covers the responsibilities of employer, employee, and regulatory agencies in maintaining safety. Discusses ways of identifying and handling chemical, electrical, biological, radiation, and mechanical hazards. Discusses importance of maintenance (including calibration) and proper record keeping. Describes use of common electrical and electronic test instruments. Offers guidelines for handling heavy equipment, decontaminating and servicing pneumatic and hydraulic equipment, and troubleshooting.

TPC 281 - Working With Controllers

Covers the purposes and kinds of controllers and their relationship to other components in process control systems. Explains the concepts of current-, position-, and time-proportioning control. Compares the operation of several kinds of controllers. Describes the operation of proportional, integral, and derivative modes, and discusses tuning procedures for each. Discusses cascade, feedforward, ratio, and auctioneering control systems as well as other operations. Describes ways to eliminate or reduce controller problems.

TPC 282 - How Control Loops Operate

Covers definition of control loop terms and characteristics. Includes specific examples of operation of control loops of many kinds. Discusses proportional, integral, and derivative modes in detail. Describes advanced control methods by means of four strategies with specific examples. Examines the effects of loop dynamics on system stability.

TPC 283 - Data Transmission

Covers mechanical, hydraulic, pneumatic, and telemetric data transmission methods. Discusses

indicators, other devices, and methods used for electrical/electronic data transmission in detail. Compares methods and standards for parallel and serial digital data transmission. Describes optical isolation and the operation of optical data transmission systems in detail. Provides specific methods for preventing common kinds of data

TPC 284 - Computers in Process Control

Covers the evolution of today's process control computer systems. Compares smart components to older conventional system devices. Covers the architecture (hardware and software), configuration, and operation of distributed control systems in depth (two entire lessons) by using as an example a typical DCS controlling an ice cream plant. Defines common terms used in today's integrated plant and discusses the integration of discrete and continuous processes with plant business functions.

TPC 291 - Digital Logic Systems

Covers the comparison of analog and digital switching circuits. Explains Boolean logic functions. Describes TTL and CMOS logic, as well as IC logic devices. Explains how flip-flops, clock circuits, counters, multiplexers, and memory circuits work. Describes the sections and interfaces in functional logic systems, including microprocessors. Describes proper methods for detection and correction of common fault potentials

TPC 298 - Programmable Logic Controllers

Prepares technicians to take full advantage of vendor training on specific equipment. Covers the basic operating principles of all PLCs, their inputs and outputs, programming, maintenance, and networking.

TPC 301 - Basic Mechanics

Covers force and motion, work and energy, and fluid mechanics as applied in industrial maintenance. Explains principles of operation for simple machines, such as the lever, inclined plane, wheel and axle, pulley, and screw. Explains the basic elements of industrial machines, as well as common measurement

tools used to monitor and adjust equipment. Covers hand tools, power tools and fasteners, ending with a discussion of ways to reduce friction and

TPC 416 - Blueprint Reading for Welders

Covers basic shop math and measurement skills. Explains how to read, use, and make blueprints. Discusses various welds, weld joints, and weld symbols. Explains advanced shop math and measurement skills.

TPC 417 - Welding Principles

Covers fundamentals of welding, Discusses welding safety considerations and precautions. Covers both oxyfuel and arc welding equipment. Describes welding techniques and symbols. Discusses ways to avoid weld faults.

TPC 418 - Oxyfuel Operations

Covers the welding of ferrous and nonferrous metals. Describes oxygen cutting as well as brazing and soldering. Discusses surfacing techniques.

TPC 419 - Arc Welding Operations

Covers shielded metal arc welding, selecting electrodes for SMAW, gas metal and tungsten arc welding, preheating, reheating, welding ferrous and nonferrous metals, pipe welding, hard facing, and rebuilding.

WATER 200 - Introduction to the Water Industry

This course provides an overview of the water treatment program and the water treatment industry. It introduces students to water and wastewater treatment occupations and processes. Students study operator roles, industry requirements, common terminology and basic equipment as well as water use and characteristics.

WATER 201 - Laboratory Basic Procedures and Basic Water Chemistry

Introduction to lab procedures and safety along with the study of chemistry as it applies to the water molecule.

WATER 202 - Chemical, Physical and Biological Water Impurities

Survey of how the water molecule carries chemical, physical and biological impurities. Measurement, sample collection technique and impurity removal processes are also covered.

WATER 203 - New Water Operator Training

This course is meant to introduce the student to the skills and concepts they will need to be successful as operators working in the Water and Wastewater industry. Topics include, but are not limited to: basic mathematics, water chemistry, treatment processes and an introduction to equipment such as pumps and valves

WATER 204 - Water Equipment Studies

Introduction to pumps, compressors and auxiliary equipment in plants. Design and operational concepts are covered.

WATER 206 - Water Plant Collection and Pretreatment Processes

This course focuses on groundwater and surface water collection processes including wells and surface collection processes. Pretreatment processes covered include chemical additions, aeration, screening and ponds.

WATER 208 - Non-dissolved Solids Clarification and Filtration Processes

This course focuses on the removal of non-dissolved solids measured as turbidity. Processes covered include settling basins, clarification, and filters.

WATER 210 - Dissolved Solids, Chemical Softening and Ion Exchange Processes

This course focuses on the addition of lime to clarification processes, advanced filtration, reverse osmosis, sodium based softening and high purity ion exchange processes.

WATER 212 - Potable Water and Disinfection Processes

This course focuses on disinfection processes including all forms of chlorine addition, ozone and ultraviolet light. Potable water regulation and requirements are also covered in depth.

WATER 214 - Water Distribution & Final Treatment Processes

This course focuses on final water treatment processes for potable water. In addition, distribution concepts and equipment including trenching safety are surveyed.

WATER 216 - Wastewater Treatment Processes

This course focuses on wastewater treatment processes including collection, flow stabilization, grit removal, settling, clarification, aerobic and non-aerobic digestion and sludge processing.

WATER 218 - Pump and Motor Maintenance

This course focuses on the operation and maintenance of equipment used in wastewater collection and treatment. Troubleshooting of wastewater treatment systems is also reviewed.

WATER 220 - Instrumentation and Control

This course focuses on a study of instrumentation components, control theory, control systems, controllers and SCADA associated with the operation of a facility.

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		**All courses available for custom apprenticeship tracks						
COURSE NUMBER AND TITLE	CONTACT HOURS	METERING TECHNICIAN	RELAY-APPARATUS TECHNICIAN	SUBSTATION ELECTRICIAN	SYSTEM PROTECTION ELECTRICIAN	TELECOMMUNICATIONS	MECHANICAL MAINTENANCE	WATER OPERATIONS SPECIALIST
APP 100 – Introduction to the Electrical Industry & Power Grid	48							
APP 106 – Basic Electricity I	32	■						
APP 108 – Basic Electricity 2	48	■						
APP 111 – Math I	48	■	■	■	■			
APP 112 – Math II	64	■	■	■	■			
APP 114 – Industrial Safety & Health	48	■	■	■	■			
APP 119 – Troubleshooting and Emergency Repair of DC/AC Systems and Equip	20		■	■	■			
APP 120 – Industrial Prints and Diagrams	64	■	■	■	■	■		
APP 133 – Electrical System Components	48							
APP 137 – Power Quality	20	■						
APP 152 – Safety in Substations and Switchyards	20	■			■			
APP 153 – Transformer Maintenance	48			■	■			
APP 160 – Introduction to Transmission and Distribution Systems	48	■	■		■	■		
APP 161 – Electrical System Protection	48	■	■		■			
APP 163 – Power Flow	48	■	■		■			
APP 164 – Control Equipment, Substation and Switchyards	64		■		■			
APP 165 – Using Line Test Equipment	20	■			■			
APP 167 – DC Power Systems	20					■		
APP 170 – Relays I and II	64	■	■		■			
APP 171 – Capacitors and Reactors	20	■	■					
APP 175 – Current Transformers	20	■	■					
APP 180 – Introduction to Metering	48	■			■			
APP 181 – Instrument Transformers and Polyphase Metering 1 and 2	32	■	■		■			
APP 182 – Watthour Meter Principles	48	■	■		■			
APP 190 – Operator Fundamentals of GIS and GPS	8							■
APP 204 – Advanced Electrical System	64							

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APP 210 – Overhead Transmission & Distribution Line Construction	64							
APP 230 – Underground Line Construction	64							
APP 232 – Electrical System Design	48				■			
APP 240 – Power Industry Concepts	48							
APP 250 – Electrical Generation Theory	64							
APP 251 - Substation Construction & Maintenance	64							
APP 252 - Civil Design	32							
APP 254 - System Elements I - Substations	48	■						
APP 256 - System Elements II - Transformers	48	■						
APP 258 - System Elements III - Protective Relaying	48	■						
APP 260 - Electrical Diagram Interpretation	32							
APP 262 - Power System Operations	48							
APP 266 - Interconnected System Operations	48							
APP 270 - System Operator Work Practices	48							
APP 272 - Power System Safety	48							
APP 274 - Communication & Control Technology	32							
APP 276 - Power System Economics	48							
APP 278 - Power System Emergency Concepts	48							
APP 280 - Reliability Policies & Procedures	48							
MMAT 105 - Hand & Portable Tools	32						■	
MMAT 109 - Measurements	32						■	
MMAT 111 - Schematics, Symbols & Blueprints	32						■	
MMAT 113 - Industrial Rigging	16						■	
MMAT 115 - Lubrication, Bearings & Seals	32						■	
MMAT 117 - Material Handling Systems	16						■	
MMAT 119 - Troubleshooting Skills	16						■	
MMAT 150 - Mechanical & Fluid Drive Systems	32						■	

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MMAT 155 - Hydraulics & Pneumatics	32		■	■			■	
MMAT 160 - Valves & Steam Traps	48						■	
MMAT 162 - Piping & Tubing Systems	16						■	
MMAT 170 - Equipment Installation	32						■	
MMAT 175 - Pumps, Compressors & Turbines	64						■	
MMAT 205 - Basic Electricity and Electronics							■	■
TELEC 101 - Microwave Fundamentals	30					■		
TELEC 102 - Digital Hierarchy	30					■		
TELEC 103 - Multiplex Equipment	30					■		
TELEC 104 - Fiber Optics	30					■		
TELEC 120 - Antenna Systems	30					■		
TELEC 121 - Filter Systems	30					■		
TELEC 122 - Grounding Systems	30					■		
TELEC 123 - GPS	30					■		
TELEC 132 - Key Systems	30					■		
TELEC 133 - Ethernet	30					■		
TELEC 135 - PBX & VOIP	60					■		
TELEC 140 - SCADA	30					■		
TELEC 141 - Basic Networks & SNMP	30					■		
TELEC 142 - Microsoft Visio	30					■		
TPC 102 - Reading Schematics and Symbols	20							
TPC 105 - Metals in the Plant (or Metallurgy Equivalent)	20							
TPC 106 - Nonmetals in the Plant (or Metallurgy Equivalent)	20							
TPC 110 - Developing Troubleshooting Skills	20							
TPC 114 - Waste-to-Energy Fundamentals	14							
TPC 202 - Batteries and DC Circuits	20		■	■				
TPC 203 - Transformers and AC Circuits	20							

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TPC 204.1 - Electrical Measuring Instruments	10			■				
TPC 205.1 - Electrical Safety & Protection	12		■	■				
TPC 206 - DC Equipment and Controls	20		■	■	■			
TPC 207 - Operating and Maintaining Single-Phase Motors	20		■	■		■		
TPC 208 - Operating and Maintaining Three-Phase Systems	20		■	■	■	■		
TPC 209 - Understanding Basic AC Control Equipment	20			■				
TPC 210 - Developing Electrical Troubleshooting Skills	20		■	■	■	■		
TPC 251 - Semiconductors	10				■			
TPC 252 - Power Supplies	12			■	■			
TPC 253 - Amplifiers	10							
TPC 254 - Oscillators	10							
TPC 261 - Introduction to Computers	10							
TPC 262 - Input-Output Devices I	10		■	■	■			
TPC 266 - How Computers Function	10				■			
TPC 267 - Input-Output Devices II	10		■	■	■			
TPC 268 - Maintaining/Troubleshooting Computer Systems	10		■		■			
TPC 271 - Introduction to Process Control	10							
TPC 273 - Pressure Measurement								
TPC 274 - Force, Weight & Motion Measurement	10							
TPC 275 - Flow Measurement	10							
TPC 276 - Level Measurement	20							
TPC 277 - Temperature Measurement	10							
TPC 278 - Analytical Instrumentation	10							
TPC 279 - Final Control Elements	10							
TPC 280 - Safety, Calibration and Testing Procedures	10			■	■			
TPC 281 - Working With Controllers	10							
TPC 282 - How Control Loops Operate	10							

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TPC 283 - Data Transmission	10							
TPC 284 - Computers in Process Control	10							
TPC 291 - Digital Logic Systems	10				■			
TPC 298 - Programmable Logic Controllers	10			■	■			
TPC 301 - Basic Mechanics	14							
TPC 416 - Blueprint Reading for Welders	20							
TPC 417 - Welding Principles	12							
TPC 418 - Oxyfuel Operations	14							
TPC 419 - Arc Welding Operations	10							
WATER 200 - Introduction to the Water Industry	20							■
WATER 201 - Laboratory Basic Procedures and Basic Water Chemistry	5							■
WATER 202 - Chemical, Physical and Biological Water Impurities	10							■
WATER 203 - New Water Operator Training	10							
WATER 204 - Water Equipment Studies	10							■
WATER 206 - Water Plant Collection and Pretreatment Processes	10							■
WATER 208 - Non-dissolved Solids Clarification and Filtration Processes	10							■
WATER 210 - Dissolved Solids, Chemical Softening and Ion Exchange Processes	10							■
WATER 212 - Potable Water and Disinfection Processes	10							■
WATER 214 - Water Distribution & Final Treatment Processes	10							■
WATER 216 - Wastewater Treatment Processes	6							
WATER 218 - Pump and Motor Maintenance	15							■
WATER 220 - Instrumentation and Control	8							■