Apprentice Communications Technician (D805 - Job Class 7653)

Section A. General

The following outline of training programs, courses and study requirements shall constitute an obligation on the part of the Company to provide job training, study materials and courses as outlined, and to keep records thereon, for all apprentices assigned to the classification of Apprentice Communications Technician and shall constitute an obligation on the part of the employees so assigned to participate in the training programs and in the keeping of records of progress as herein outlined.

The Company will furnish a copy of the Supplementary Agreement for Administration of Apprenticeship Programs and this Schedule of Training Hours and Courses to all employees assigned to the classification of Apprentice Communications Technicians subsequent to the date of this Supplementary Agreement. The Apprentice Communications Technician Training Program will consist of two basic parts.

a. On-the-job training will be provided wherein the employee should learn the practical skills necessary for journeyman status.

b. Supplementary classroom and home study training should provide the employee with basic knowledge of electronics and telecommunication theory as well as a better understanding of the diverse types of technical skills, equipment, software, and procedures with which he/she will be working.

Section B. Job Training Program

Work Assignments: Journeymen are responsible for the on-the-job training and Supervision is responsible for the proper rotation of the apprentice's work assignments for him/her to get training in all phases of the craft. The responsibility for evaluating and documenting the work of the apprentice rests with the immediate journeyman and foreman.

Each apprentice shall be assigned work that will provide him/her experience in all phases of a Communications Technician to include all aspects installation, construction, and maintenance. During all phases of the apprentice training programs, instruction of proper safety procedures and practices will be provided.

Section C. Job Standards

Minimum Requirements: To provide each apprentice with at least a minimum amount of experience on each of the various types of systems and equipment, upon which the apprentice may be required to work as a Journeyman, he/she should be assigned work and given instructions in amounts meeting or exceeding those shown in the OJT hours tabulation.

Section D. Safety

In conjunction with the performance of work assignments, instruction on the following safety practices will be included with the on-the-job and classroom training:

- Care and use of personal tools
- Care and use of crew tools and equipment
- Proper operation of bucket truck, UTV, trailers and Snow Cats
- Vehicle operation on and off road
- Care and use of protective equipment

- Basic first aid and CPR
- Tailboard briefings

Apprentices should be encouraged to discuss their problems with the foremen and supervisor. Foremen and supervisor will assist and encourage the apprentice in their work.

Section E. Testing

Grading of tests shall be done by the instructor, general foreman, or supervisor. The apprentice shall be notified of grades received from lesson tests. Lesson tests determine the apprentice's progress in the Supplementary Study Course and shall be given upon completion of each lesson of the course and shall be prescribed for the course or as approved by the supervisor or general foreman and the record of grades shall be made a part of the apprentice's record.

In an effort for an apprentice to top out, the following guidelines may be used. The apprentice will be given a final test and practical application before topping out. This written test and practical application test will be administered within his/her last six months and may be administered no earlier than 90 days prior to his/her completion date.

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Section F. On-The-Job (OJT) Training Hours

Communications Technician
Program Duration: 4 Years (48 Months)

The following is an outline of the subjects to be covered in the on-the-job training, supplementary training and classroom, and home study program:

Process	Hours
I. Telecom Auxiliary Systems	
Power and DC Distribution Systems	400
Uninterrupted Power Supply System	40
Generator Backup System	100
Telecom Alarm System	280
Timing Systems	100
HVAC Equipment	40
Wire and Fiber Management	260
Testing Equipment, Systems, and Software	200
Total	***1420***
II. Energy Management Systems	
SCADA System Components	240
Communications Front End Processor / Modems	240
SCADA Remote Terminal Units	640
Interface with Line and Meter Equipment IEDs	320
Protocols / Analyzers	160
Management Software	120
Total	***1720***
III. Telephone Systems	
VOIP System	140
T1 Systems	220
DSO Circuits	220
Total	***580***

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IV. Relay and Protection Systems	
RAS Schemes	80
Relay Protection	240
Power Line Carrier / Tone Equipment	180
Mirrored Bits Equipment	40
Direct/Permissive	80
Total	***620***
V. Land Mobile Radio Systems	
Consoles	80
Subscriber Units	180
Programming	180
Database Management	120
IMC	160
LMR Base Site Equipment	240
Total	***960***
VI. Transport Systems	
Microwave Radio	600
Multiplexers	600
DACS	200
Optical Fiber Transport Systems	540
Networking	420
MAS Radio	220
Total	***2580***
VII. Safety	
Safety Training and Meetings	60
Vehicle Operation	60
Total	***120***

Total Program Hours 8,000

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Section G. OJT Hours Summary:

- Telecom Auxiliary Systems (Total 1420 Hours)
    - Power and DC Distribution Systems (400 Hours)
        - Installation and maintenance of DC controller and rectifiers
        - Installation and maintenance of telecom battery plants
        - Installation and maintenance of AC / DC distribution
            - Fuse Panel
            - Cabling
            - Breakers and Fuses
        - Installation and maintenance AC / DC Inverters and Converters
        - Installation of grounding equipment and standards
    - Uninterrupted Power Supply System (40 Hours)
    - Generator Backup Systems (100 Hours)
        - Generator operation and maintenance
        - Transfer switch operation and maintenance
        - Fuel Supplies and sensors
    - Telecom Alarm Systems (280 Hours)
        - Alarm management system and configuration
        - Remote unit installation, configuration, and maintenance
        - Remote sensors installation
        - Remote management and verification
    - Synchronization and Timing Systems (100 Hours)
        - Installation, configuration and maintenance of GPS antenna and timing sources
        - Installation, configuration, and maintenance of Building Integrated Timing Systems (BITS Clock)
    - HVAC Equipment (40 Hours)
        - Operation of thermostat and alarming
        - General maintenance
    - Wire and Fiber Management (260 Hours)
        - Basic telecom wiring standards and color codes
        - Terminal Block installation and maintenance
            - 66 / 110 Punch
            - Wire wrap
            - Network management termination panels
        - Fabrication and installation of Amphenol connectors
        - Installation and maintenance of fiber optic patch panels
        - Installation and maintenance of fiber optic patch cables
        - Fabricate, install and maintain fiber optic jumpers
    - Testing Equipment, Systems, and Software (200 Hours)
        - Test Equipment operation
            - OTDR, OLTS, and fiber optical scoping and testing
            - DS3, DS1, and DS0 Testing / VF Testing
            - Network Testing equipment
            - Spectrum Analyzer, Power Meters, RF Meters
    - Software
        - NMNS management
        - Equipment interface with terminal emulation

        - Remote management

- Energy Management Systems (Total 1720 Hours)
    - SCADA System Components (240 Hours)
    - Communications Front End Processor (240 Hours)
        - FEP
        - Modem installation, configuration, and maintenance
    - SCADA Remote Terminal Units (640 Hours)
        - Installation, configuration, and maintenance of legacy and current RTUs
        - Configuration management
        - CIP requirements
    - Interface with Line and Meter Equipment / IEDs (320 Hours)
        - Interface with RTU and communication with Metering equipment
        - Configuration, installation, and maintenance for communication to reclosers, motor operators, and TGB Devices.
    - Protocols / Analyzers (160 Hours)
        - Knowledge and programming of protocols such as DNP, Harris, Telegyr, Conitel, and Modbus
        - Ability to utilize protocol analyzers in the troubleshooting and verification of data streams from RTU devices.
    - Management Software (120 Hours)

- Telephone Systems (Total 580 Hours)
    - VOIP System (140 Hours)
        - Programming, installation, and repair of VOIP phone system
    - T1 Systems (220 Hours)
        - Installation, configuration, and troubleshoot of T1 Channel Banks, Multiplexers, and equipment
        - Install, Wire and test using DSX jack fields intrusive and nonintrusive
    - DS0 Circuits (220 Hours)
        - Wiring and Testing
        - VF jack fields

- Relays and Protection Systems (Total 620 Hours)
    - RAS Schemes (80 Hours)
    - Relay Protection (240 Hours)
        - Installation, testing and maintenance of protection circuits
            - Direct fiber / Media Converters
            - Serial
            - C37.94
        - PRC-005-06 compliance testing
    - Power Line Carrier / Tone Equipment (180 Hours)
        - Installation, testing and maintenance on PLCE and Tones 9745, Type 40, TA 1 / 3
    - Mirrored Bits Equipment (40 Hours)
    - Directive / Permissive (80 Hours)

- Land Mobile Radio Systems (Total 960 Hours)
    - Consoles (80 hours)

        - Console configuration, updating and maintenance
    - Subscriber Units (180 Hours)
        - Installation, configuration, and maintenance of mobile radio in vehicles
        - Installation, configuration, and maintenance of hand-held radios
    - Programming (180 Hours)
        - EDACS
        - P25
    - Database Management (120 Hours)
    - IMC (160 Hours)
    - LMR Base Site Equipment (240 Hours)
        - EDACS and P25 system operation, configuration, and maintenance
        - Auxiliary support equipment

- Transport Systems (Total 2580 Hours)
    - Microwave Radio (600 Hours)
        - Installation, configuration, and maintenance of digital radio systems
        - Antenna support structures and transmission medium knowledge, installation, and maintenance
        - Dehydrator Systems installation and maintenance
    - Multiplexer (600 Hours)
        - Installation, configuration, and maintenance of multiplexers
    - DACS (200 Hours)
        - Configuration and maintenance of digital cross connect system
    - Optical Fiber Transport Systems (540 Hours)
    - Networking (420 Hours)
        - MPLS router installation, configuration, and maintenance
        - Assist IT / OT on network switch installations
        - Network cabling fabrication and testing
    - MAS Radio Systems (220 Hours)

- Safety (Total 120 Hours)
    - Safety Training and Meeting (60 Hours)
        - Personal protective equipment
        - Safe operational distances
        - Substation training
        - Tailboards / Safety Manual
        - MSHA
        - Ladder
        - Tools
    - Vehicle Operation (60 Hours)
        - UTV
        - Trailers
        - Snow Cats
        - On and off-road driving

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Section H. Training Plan Outline

Upon start as a Telecom Apprentice, the apprentice will be assigned substation training and complete all safety required courses on NVE Learning Management system. The apprentice will be provided all personal protective equipment and scheduled for MSHA training. Apprentice will be introduced to all safety requirements and pre-job brief / tailboard documentation. The apprentice will be required to attain his/her FCC license and will be sent to a one-week course during the apprenticeship. On a seniority basis, the apprentice can volunteer to attain a commercial driver's license depending on department needs.

Throughout the program, the apprentice will be assigned to different foremen and journeymen to provide adequate on-the-job training and classroom time to prepare him/her to become a journeyman. Additionally, the apprentice will be assigned NVE Learning Management System (LMS) courses that are relevant to their education and skill development. The Telecom Apprentice Training will build off fundamentals and telecommunication basics and apply those skills to the more complex tasks.

The apprentice will spend his/her first year progressing through Safety, Telecom Auxiliary Systems and Telephone Systems to provide the general skills for telecommunication, safety procedures and area familiarity. The second year will advance to Relay and Protection Systems and start into the Transport Systems. The third year will complete the Transport Systems and start Energy Management Systems. The fourth year will finish Energy Management Systems and focus on Land Mobile Radio Systems. Due to the nature of Telecom Operations work and vast operational area, the apprentice will be introduced and track hours across several of the processes during a progression period.

Section I. Step Progression

Classroom room training and progression testing will focus on the outlined training plan:

Step 1 (Six Months)

- Safety
- Telecom Auxiliary Systems
    - Wire and Fiber Management
    - Testing Equipment, Systems, and Software
    - HVAC Equipment
    - Uninterrupted Power Supply System
- Telephone Systems
    - T1 Systems
    - DSO Circuits

Step 2 (1 Year)

- Telecom Auxiliary Systems
    - Power and DC Distribution Systems
    - Telecom Alarm System
    - Generator Backup System
    - Timing Systems
- Telephone Systems
    - VOIP System

Step 3 (1.5 Years)

- Relay and Protection Systems
    - RAS Schemes

    - Relay Protection
    - Power Line Carrier / Tone Equipment
    - Mirrored Bits Equipment
    - Direct/Permissive
- Transport Systems
    - DACS
    - MAS Radio

Step 4 (2 Years)

- Transport Systems
    - Microwave Radio
    - Networking

Step 5 (2.5 Years)

- Transport Systems
    - Multiplexers
    - Optical Fiber Systems

Step 6 (3 Years)

- Transport Systems
    - Optical Fiber Systems
- Energy Management Systems
    - SCADA System Components
    - Communications Front End Processor / Modems
    - SCADA Remote Terminal Units

Step 7 (3.5 Years)

- Energy Management Systems
    - SCADA Remote Terminal Units
- Land Mobile Radio Systems
    - Consoles
    - Subscriber Units
    - Programming
    - Database Management
    - IMC
    - LMR Base Site Equipment

Step 8 (4 Years)

- Process reviews
    - Telecom Auxiliary Systems
    - Energy Management Systems
    - Telephone Systems
    - Relay and Protection Systems
    - Land Mobile Radio Systems
    - Transport Systems
- Top Out Testing

Section J. Supplemental Training

Supplemental Training Program Outline
Supplemental Training Module Approximation Summaries

1. Learning Strategies 5 hours
   Penn Foster Lesson # 147008 Penn Foster Exam # 14700803
   - Features of the program
   - How to get help during studies
   - The program study materials and how they are obtained
   - Access to Penn Foster Web Site
   - Types of learners
   - How to establish a study schedule, organize materials, and choose appropriate study locations
   - The SQ3R study method
   - Proper procedure for building working vocabulary
   - Proper procedure for preparing and taking examinations

2. Jobs, Companies, and the Economy-Basic 5 hours
   Penn Foster Lesson # 186034 Penn Foster Exam # 18603400
   - Conclude how the economy affects consumers and employees
   - Explain the concept of competition and how a business must react to market demands
   - Evaluate how government policies affect the amount of saving and investing within an economy
   - Defend the use of a flexible and empowered workforce in making a business more competitive
   - Explain various economic measuring tools such as the inflation rate, the unemployment rate, and the GDP
   - Appraise the current status of American labor in general and the status of American labor unions in particular
   - Recognize how an employee or employer must compete in an increasingly international marketplace

3. Quality Concepts: Tools and Applications 5 hours
   Penn Foster Lesson # 186036 Penn Foster Exam # 18603600
   - How job roles change as a company evolves in its quality-consciousness
   - Several ways in which you can support TQM
   - Approaches, practices, and skills associated with positive organizational changes
   - The “change process” at the company level vs. “manufacturing processes” that require improvement
   - Major causes of process variation and examples of how they may affect the employee
   - Why and how the reduction of variability is a key factor in process improvement
   - Why and how quality and process improvement depend on data-driven decision making
   - Seven quality tools and how to use them

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4. Trades Safety Getting Started 5 hours
   Penn Foster Lesson # 186001 Penn Foster Exam # 18600100
   - Physical hazards associated with chemicals and how to avoid those hazards
   - Electrical shock hazards
   - Steps in a lock-out and tag procedure
   - Importance of machine guarding and identifying types of machine guards
   - Four classes of fire and how to extinguish each of them
   - Proper technique used to lift a heavy load
   - How to avoid hand injuries when using hand tools and power tools
   - Some of the hazards involved in welding and hot cutting operations and how to prevent them
   - How job analysis and the science of ergonomics are used to improve the workplace
   - Types of personal protective equipment (PPE) and the importance of using PPE

5. Materials-Handling Safety 5 hours
   Penn Foster Lesson # 186006 Penn Foster Exam # 18600600
   - Recognizing the hazards associated with handling materials
   - Types of injuries that can be caused by such hazards
   - Understanding how to effectively use safe material-handling practices
   - Knowing how to avoid physical injury when handling loads
   - Knowing and following the rules for safe operation of powered industrial material- handling equipment
   - Understanding and respecting the limits and restrictions placed on powered material-handling mechanisms

6. Introduction to Telecommunications 10 hours
   Penn Foster Lesson # 387001 Penn Foster Exam # 38700100
   - Everyday applications of telecommunications
   - Differences between analog and digital signals
   - Mediums that are used to carry data communications
   - Bandwidth characteristics in a telecommunications link
   - Basic differences between active and passive communications satellites
   - Testing instruments used by telecommunications technicians
   - Potential employers of telecommunications technicians
   - Common electrical shock hazards
   - Steps in a lockout and tag procedure
   - Types and importance of personal protective equipment (PPE)

7. Nature of Electricity 5 hours
   Penn Foster Lesson # 086001 Penn Foster Exam # 08600101
   - Operation of a simple circuit
   - Conductors, insulators, and resistors
   - Electrical charge forces
   - Dangers and benefits of static electricity

- Volts, amperes, and ohms
- Common notations and prefixes used to identify electrical and electronic values
- Types of resistors
- Electrical symbols used in schematic diagrams
- Series and parallel circuits

8. Working Safely with Electricity 10 hours

Penn Foster Lesson # 4400 Penn Foster Exam # 44008

- Listing the major electrical classifications and describe the job functions associated with each
- Influence of the National Electric Code on manufacturers, installers, and users of electrical equipment
- Safe work habits that lessen the chances of serious electric shock by avoiding those conductive paths most dangerous to the human body
- Safety equipment required to be worn when installing or repairing electrical equipment

9. Electrician's Tools 10 hours

Penn Foster Lesson # 006026 Penn Foster Exam # 602600

- Explaining how various hand tools are used by an electrician
- Discussing the safe use of hand tools and power tools
- Performing basic calculations and measurement conversions using the metric system
- Using Ohm's law to explain the relationship between current, voltage, and resistance in a circuit
- Explaining how electrical measuring instruments are used to measure current, voltage, and resistance
- Defining many of the basic electrical terms that electricians use everyday
- Identifying the basic symbols used in electrical schematic drawings

10. Linear Distance and Measurement 5 hours

Penn Foster Lesson # 186021 Penn Foster Exam # 18602101

- Measurement using both English and metric units of length
- Calculating the perimeters of rectangles, squares, and triangles
- Calculating the areas of objects such as rooms or machine bases
- Calculating the circumference of circular objects such as pipes or tanks
- Measuring distances using rigid and flexible rules, thickness gauges, and screw pitch gauges
- Making precise measurements using vernier calipers and micrometers

11. Electrical Drawings and Circuits 8 hours

Penn Foster Lesson # 186044 Penn Foster Exam # 18604400

- Identifying electrical construction drawings, schematics, and wiring diagrams
- Interpreting various electrical symbols
- Reading standard abbreviations used in electrical diagrams
- Block diagrams, schematic diagrams, and wiring diagrams

- Closed circuits, open circuits, grounded circuits, and short circuits

12. Reading Electrical Schematic Diagrams 10 hours
Penn Foster Lesson # 006022 Penn Foster Exam # 00602202
- Standard electrical symbols and their meanings
- Parts of a schematic diagram
- Flow of electrical current through devices
- Interpreting electrical drawings, block diagrams, wiring diagrams, and electrical schematic diagrams
- Characteristics of switched circuits
- Ladder diagrams and their functions

13. Problem Solving and Troubleshooting 10 hours
Penn Foster Lesson # 186073 Penn Foster Exam # 18607300
- Problem solving, trouble shooting, and critical thinking
- Applying logic to solving problems and troubleshooting systems
- Tools used for problem solving and troubleshooting
- Tools and measurement devices that help in troubleshooting common industrial systems
- Collecting information related to problem solving
- Improving personal meta-cognitive abilities to analyze complex systems

14. Fractions, Percentages, Proportions, and Angles 5 hours
Penn Foster Lesson # 186010 Penn Foster Exam # 18601000
- Defining the following terms: fraction, proper fraction, lowest common denominator, percent, ratio, and proportion
- Adding, subtracting, multiplying, and dividing fractions
- Changing fractions to decimals and decimals to fractions
- Solving problems involving percentages
- Working with ratios and equivalent ratios
- Solving proportion problems
- Using a protractor to measure angles
- Laying out templates for checking angles
- Using a calculator to solve percent problems, to convert fractions to decimals, and to calculate missing terms in proportions

15. Formulas 5 hours
Penn Foster Lesson # 186012 Penn Foster Exam # 18601200
- Explaining the use of variables in formulas
- Preparing and using formulas to solve problems
- Using formulas to calculate the perimeter of a triangle and a rectangle, and the areas of a triangle, a rectangle, and a circle
- Using formulas to calculate the distance, current in a circuit, and the volume of a pyramid and a sphere
- Using a calculator to find square roots and solve formulas
- Substituting given numerical values for letters in a formula and finding the unknown quantity
- Transforming and solving equations and formulas

16. Circuit Analysis and Ohm's Law 5 hours
Penn Foster Lesson # 086002 Penn Foster Exam # 086200200
- Total resistance in series, parallel, and series-parallel circuits
- Using Ohm's law to calculate the amount of current, voltage, or resistance in circuits
- Calculating the amount of power supplied and dissipated in a DC circuit
- Reading current, voltage, and resistance with a meter

17. Basic Test Equipment 5 hours
Penn Foster Lesson # 086025 Penn Foster Exam # 08602500
- Identifying the schematic symbols used to represent various reactive devices
- Relationships between voltage, current, and resistance in a circuit
- Measuring voltage, current, and resistance with a multimeter
- Features of analog and digital VOMs
- Using analog and digital VOMs to measure voltage, resistance, and current in a circuit
- Safety precautions when using a multimeter

18. Troubleshooting with Volt-Ohm Milliamp Meters (VOMs) 5 hours
Penn Foster Lesson # 086026 Penn Foster Exam # 08602600
- Safe practices when troubleshooting with a VOM
- Continuity Testing
- Short Circuit Testing
- Resistance Testing on Electronic Components
- Current Measurements
- Measuring input and output voltages of DC power supplies
- Measuring voltages on disconnect switches, circuit breakers, contactors, and transformers
- Voltage tests on circuit boards, PLC systems and motor circuits

19. Using Basic Oscilloscopes 5 hours
Penn Foster Lesson # 086027 Penn Foster Exam # 08602701
- Oscilloscope controls and operation
- Performing low-voltage measurements on circuit boards
- Measuring the voltage output of a power supply and AC ripple
- Measurements in SCR and TRIAC circuits
- Testing AC and DC servo motor and heater controller circuits
- Basic oscilloscope measurements on digital circuits

20. Component Testers 6 hours
Penn Foster Lesson # 086062 Penn Foster Exam # 08606200
- Identifying the type of component tester used in connection with resistors, capacitors, and inductors
- Calculating turns ratio
- Correct connection schemes for testing diodes, SCRs, ant transistors

21. Digital Test Equipment 6 hours
Penn Foster Lesson # 086063 Penn Foster Exam # 08606300
- Converting between decimal, binary, octal, and hexadecimal numbering systems
- Logic gate applications
- Flip-flop storage applications
- Using logic probes and IC logic clips
- Troubleshooting digital systems using oscilloscopes and logic analyzers

22. Industrial Computer Networks 6 hours
Penn Foster Lesson # 08606900 Penn Foster Exam # 08606900
- Methods of communications within networks
- Configurations of various types of industrial network systems
- Types of network cables
- Network protocols
- Troubleshooting methods for networks

23. Communication Cabling Systems 5 hours
Penn Foster Lesson # 086801 Penn Foster Exam # 08680100
- Precursor Technologies of Telecommunications
- Evolution of Telecommunications Wiring
- Planning Wiring Installations
- Computer Network Standards
- UTP cabling connections and terminations

24. Copper Wiring for Telephone, Video, and Network Systems 5 hours
Penn Foster Lesson # 086802 Penn Foster Exam # 08680200
- Basic methods of installing telephone, video and network cabling
- Planning a cable installation
- Factors affecting the quality of a cable installation
- Media types for telephone, video and network cabling
- Installation techniques
- Workplace security and safety

25. Terminating and Testing Communication Wiring 5 hours
Penn Foster Lesson # 086083 Penn Foster Exam # 08680300
- Advantages and disadvantages of wireless networking
- Selecting and Installing wireless access points
- Basic cable testing tools

26. Working with Fiber Optics 5 hours
Penn Foster Lesson # 086084 Penn Foster Exam # 08608400
- Fundamental principles of fiber optic transmission
- Different types of fiber-optic cabling
- Common types of optical fiber connections, terminations, and splices
- Pulling, cleaving, connecting, and polishing optical fiber cables
- Types and methods of fiber-optic testing

27. Introduction to Algebra 5 hours
Penn Foster Lesson # 186013 Penn Foster Exam # 18601300
- Explain the difference between positive and negative numbers and their uses
- Performing basic arithmetic operations with signed numbers
- Raising a number to any power
- Using the order of operations for solving problems involving multiple operations
- Defining the following words: term, constant, coefficient, exponent, monomial, trinomial, and polynomial
- Identifying and combining like terms in an expression
- Performing basic arithmetic operations with signed terms
- Multiplying and dividing terms containing exponents
- Removing parentheses from an expression and simplifying the expression

28. Algebra: Factoring 6 hours
Penn Foster Lesson # X0202 Penn Foster Exam # Omit
- Finding prime factors of certain binomials and trinomials
- Factoring a given trinomial
- Using the Factor Theorem to factor a given polynomial
- Using factoring to find the roots of an equation
- Dividing one polynomial by another polynomial of lower degree
- Finding the lowest common multiple of several polynomials

29. Algebra: Addition and Subtraction of Fractions 6 hours
Penn Foster Lesson # X0203 Penn Foster Exam # Omit
- Recognizing equivalent algebraic fractions
- Performing additions and subtractions involving algebraic fractions
- Finding the least common denominator for a group of algebraic fractions
- Reducing an algebraic fraction to its lowest terms

30. Algebra: Multiplication and Division of Fractions 6 hours
Penn Foster Lesson # X0204 Penn Foster Exam # Omit
- Performing multiplications and division involving algebraic fractions
- Solving equations involving fractions and decimals
- Simplifying complex fractions

31. Algebra: Monomials/Polynomials 6 hours
Penn Foster Lesson # X0201 Penn Foster Exam # Omit
- Removing grouping symbols from algebraic expressions, dividing by a monomial when indicated
- Multiplying binomials by monomials, trinomials, and other binomials
- Calculating the square root and the third power of given monomials
- Finding special products involving binomials
- Dividing one polynomial by another polynomial of lower degree

32. Algebra: Linear Equations 6 hours
Penn Foster Lesson # X0205 Penn Foster Exam # Omit

- Recognizing the graph of a linear equation, given the graph or a set of points
- Recognizing equations expressing mixture problems and other word problems
- Solving number problems, digit problems, and age problems.

33. Algebra: Quadratic Equations 6 hours
Penn Foster Lesson # X0208 Penn Foster Exam # Omit
- Recognizing the graphical solution of two equations
- Solving and recognizing steps in the solution of systems of quadratic equations and a system of a quadratic and a linear equation
- Solving fourth degree polynomial equations in quadratic form
- Using the quadratic formula to solve a quadratic equation, calculating the discriminant of a quadratic equation, and pointing out what can be known from a given discriminant
- Writing a quadratic equation which has given roots
- Solving word problems involving quadratic equations

34. Algebra: Exponents 6 hours
Penn Foster Lesson # X0209 Penn Foster Exam # Omit
- Demonstrating an understanding of the meaning of a fractional exponent
- Applying 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
- Writing a given number in standard form

35. Algebra: Radicals and Imaginary Numbers 6 hours
Penn Foster Lesson # X0210 Penn Foster Exam # Omit
- Simplifying several radicals and then add like terms
- Rationalizing the denominator of a fraction and eliminate an imaginary number from the denominator of a fraction
- Solving an equation containing several square roots
- Multiplying, dividing, and raising to powers terms containing radicals

36. Applied Geometry 6 hours
Penn Foster Lesson # X0211 Penn Foster Exam # Omit
- Recognizing characteristics of angles and closed plane figures
- Distinguishing between common geometric solids
- Applying the Pythagorean theorem
- Calculating the perimeter and area of a polygon, circle, and elipse
- Applying the formula for area and volume of geometric solids

37. Practical Trigonometry 6 hours
Penn Foster Lesson # X0212 Penn Foster Exam # Omit
- Defining trigonometric functions
- Using trigonometric tables and applying interpolation
- Solving right triangles
- Applying the laws of sines and cosines in solving oblique triangles

38. Electronics Hardware — 6 hours
Penn Foster Lesson # 086040 Penn Foster Exam # 08604000
- Connector and terminal types and their applications
- Wire and Cable types and applications
- Wire resistance
- Wire resistance variables
- Soldering equipment and materials selection
- Soldering techniques for PC board and SMT applications
- Special handling techniques for SMT components

39. Basic Electronic Components and Schematic Symbols — 10 hours
Penn Foster Lesson # 2020 Penn Foster Exam # 2020-4 Ed.2
- Electrical quantities
- Common electronic components
- Vacuum tubes and related devices
- Semiconductor devices

40. Conductors, Insulators, and Batteries — 5 hours
Penn Foster Lesson # 086005 Penn Foster Exam # 08600500
- Conductivity and types of conductors
- American Wire Gauge standards
- Applications in sizing conductors
- Insulating materials and temperature ratings
- Dry cells and storage batteries
- Battery arrangements
- Storage battery safety precautions
- Storage battery maintenance
- Storage battery testing
- Special types of batteries – NiCad, lithium, and others

41. Capacitors and Inductors — 5 hours
Penn Foster Lesson # 086003 Penn Foster Exam # 08600300
- Capacitor and Inductors definition
- Capacitor and Inductor principles
- Capacitor and Inductor types and ratings
- Capacitors and Inductors in series and parallel
- RC and RL time constants
- Capacitor and Inductor applications

42. Magnetism and Electromagnetism — 5 hours
Penn Foster Lesson # 086004 Penn Foster Exam # 08600400
- Magnetic poles
- Magnetic and nonmagnetic materials
- Induction magnetization
- Simple, compound, and closed magnetic circuits
- Magnetic lines of force around an energized conductor
- Right-hand rule for solenoid poles

- Electromagnetic relays, buzzers, and stepping switches
- DC motor operation
- Electromagnetic induction in generators and motors

43. Alternating Current 5 hours
Penn Foster Lesson # 086007 Penn Foster Exam # 08600701
- AC voltage waveforms
- AC cycle terms
- AC cycle time period
- AC cycle characteristic values
- Phase angles in reactive circuits
- 220 VAC, single-phase circuit operation
- Multiphase waveforms
- Power factor meters
- Delta and wye three phase circuit connections

44. Alternating Current Circuit-Principles 5 hours
Penn Foster Lesson # 086008 Penn Foster Exam # 08600800
- Electric circuit characteristics
- Circuit load applications
- Electrical components in series and parallel
- Load control from multiple locations
- Three-wire circuits
- Current in delta and wye connected circuits
- Line to line and line to neutral voltage in Y-connected circuits

45. Inductors in AC Circuits 5 hours
Penn Foster Lesson # 086009 Penn Foster Exam # 08600900
- Inductor operation in AC and DC circuits
- Inductive reactance and impedance
- AC frequency and inductive reactance
- Ohm’s law applied to inductors
- Series RL circuit impedance
- Parallel RL circuit impedance

46. Capacitors in AC Circuits 5 hours
Penn Foster Lesson # 086010 Penn Foster Exam # 08601000
- Series and parallel connected capacitance values
- Capacitive reactance
- Ohm’s law applied to capacitors
- Impedance in a series RC circuit
- Impedance in a parallel RC circuit
- AC frequency and capacitive reactance
- Resonant RLC circuits

47. Transformers 5 hours
Penn Foster Lesson # 086011 Penn Foster Exam # 08601101

- Transformer construction
- Transformer characteristics
- Transformers in 3-phase circuits
- Transformer types

48. Reactance and Impedance — 5 hours
Penn Foster Lesson # 086037 Penn Foster Exam # 08603700
- Resistors, capacitors, and inductors in DC circuits
- Timing circuits
- Calculating reactance in circuits with capacitors and inductors
- Impedance of series RLC circuits
- Voltage-current phase angles in RC, RL and RLC circuits

49. Resonant Circuits — 5 hours
Penn Foster Lesson # 086038 Penn Foster Exam # 08603800
- Time domain and frequency domain displays
- Necessary conditions for series and parallel resonance circuits
- Resonant frequency of an LC circuit
- Quality factor Q
- Q and bandwidth relationships
- Tuned circuit applications in radios
- Distributed components

50. Applications and Troubleshooting of Resonant Circuits — 5 hours
Penn Foster Lesson # 086039 Penn Foster Exam # 08603900
- Estimating voltages in troubleshooting AC and DC circuits
- Impedance matching considerations
- AC circuit filters
- Power supply filter designs
- AC filter characteristic curve
- Resonant circuits in waveguides and transmission lines
- Transmission line applications

51. Oscillators — 6 hours
Penn Foster Lesson # 086043 Penn Foster Exam # 08604300
- Types of oscillator circuits
- Flywheel effect
- Basic oscillator ciruits
- Complex RLC tuned circuits
- Oscillators with LC feedback circuits
- Oscillators with RC feedback circuits
- Oscillator circuits applicatons
- Frequency synthesizers

52. Modulation and Detection Circuits — 6 hours
Penn Foster Lesson # 086044 Penn Foster Exam # 08604401
- Forms of modulation

- Degree of amplitude and frequency modulation
- Two signal mixing
- Bandwidth of AM and FM signals
- Pulse code modulation
- Phase-locked loops
- Types of modulation circuits and components
- Types of pulse modulation

53. Learning to Solder and Desolder 3 hours
Penn Foster Lesson # 087042 Penn Foster Exam # 08704200
- Tools and materials used in soldering
- Making good solder connections
- Soldering practices
- Desoldering connections
- Desoldering practices

54. Computer Applications in Telecommunications 10 hours
Penn Foster Lesson # 387011 Penn Foster Exam # 38701100
- Four basic computer parts
- Decimal to binary and binary to decimal conversion
- Seven basic logic gates with Boolean expressions
- Converting test, pictures, and audio to binary code
- Data compression techniques
- Data encryption techniques

55. Electronics Drawings 8 hours
Penn Foster Lesson # 186045 Penn Foster Exam # 18604500
- Identifying the various electronics symbols used on drawings
- Explaining the various types of drawings used in the electronics field

56. Understanding and Using Electronic Diagrams 10 hours
Penn Foster Lesson # 2021 Penn Foster Exam # 2021-1d.2
- Fundamentals of electronic circuits
- Vacuum tubes and transistors as circuit elements
- Relays and switches as circuit elements
- Electronic diagrams in preventive and corrective maintenance
- Identifying electronic components

57. Basic Semiconductor Components: Diodes 6 hours
Penn Foster Lesson # 086019 Penn Foster Exam # 08601900
- How diodes work
- Type and function of diodes
- Diode applications
- Diode characteristics
- Diodes in electronic circuits
- Diode replacement selection

58. Rectification and Basic Electronic Devices — 5 hours
Penn Foster Lesson # 086014 Penn Foster Exam # 08601400
- Diodes and rectification
- PN junction biasing
- Transistors and amplifiers
- Transistor input and output circuits
- Rectifier outputs with and without filters
- Reversing DC output voltage polarity on rectifier schematics
- Calculating rectifier circuit ripple frequency
- Triode tubes and amplifiers

59. Rectifiers and Power Supplies — 6 hours
Penn Foster Lesson # 086041 Penn Foster Exam # 08604100
- Types of electronic rectifiers
- Types of rectifier connections
- Nonlinear component voltages and currents
- Power supply filters
- Voltage dividers in power supplies
- Calculating voltage divider component values
- Voltage-regulating devices and circuits
- Voltage and current regulation in power supplies

60. Basic Semiconductor Components: Transistors — 6 hours
Penn Foster Lesson # 086020 Penn Foster Exam # 08602000
- How transistors work
- Transistor characteristics
- Basic amplifier configurations
- Linear and non-linear amplification
- Junction Field-Effect Transistors
- Metal Oxide Semiconductor Field-Effect Transistors
- Transistors and static charges
- Troubleshooting circuits with amplifications circuits

61. Amplifiers — 6 hours
Penn Foster Lesson # 086042 Penn Foster Exam # 08604200
- Classes of transistor amplifiers
- Calculating amplifier dB gain
- Types of transistor amplifier circuits
- Methods used to bias amplifiers
- Simple troubleshooting operations on amplifiers
- Distortion introduced by amplifiers

62. Switching Devices — 6 hours
Penn Foster Lesson # 086021 Penn Foster Exam # 08602101
- Various switch types
- Basic relay ladder logic diagrams
- Diodes used as switches

- Problems with diode switching
- Rapid electronic switching
- Mechanical switches vs. rapid electronic switches

63. Electronic Sensors 6 hours
Penn Foster Lesson # 086022 Penn Foster Exam # 08602200
- Thermoelectric effects
- Bridge circuits in electronic instrumentation
- Nonlinear resistors in circuits
- Protection devices for circuits
- Stress and strain

64. Optoelectronic and Fiber-Optic Components 6 hours
Penn Foster Lesson # 086024 Penn Foster Exam # 08602400
- Electronics and optics
- Modern theories of light
- Theory of light communication
- Theory and application of barcodes
- Using infrared light in security and video systems
- Electron microscopes vs. optical microscopes
- Fluorescent and other lighting sources

65. Switching Circuits 6 hours
Penn Foster Lesson # 086054 Penn Foster Exam # 08605400
- Output conditions for various gate circuits
- Application of transistors in gate circuits
- Operation of multi-vibrators and flip-flops
- Various logic families
- Application of Boolean algebra in logic circuitry

66. Logic Circuits 6 hours
Penn Foster Lesson # 086055 Penn Foster Exam # 08605500
- Binary vs. other numbering systems
- Truth tables
- Encoders, decoders, and converter circuits
- Adders, subtracters, and comparators

67. Gating and Counting Circuits 6 hours
Penn Foster Lesson # 086056 Penn Foster Exam # 08605600
- Arithmetic logic gates
- Half-adder and full-adder circuits
- Use of half-adder circuits
- Decade and binary counters
- Modulus of a counter

68. Pulse and Digital Circuits 6 hours
Penn Foster Lesson # 086057 Penn Foster Exam # 08605700

- Characteristics of electronic pulses
- Time constants in pulse-forming circuits
- Waveforms for integrating and differentiating circuits using pulse inputs

69. Electronic Devices and Amplification 6 hours
Penn Foster Lesson # 086045 Penn Foster Exam # 08604500
- Passive and active devices
- Voltage, current, and impedance relationships in transformers
- Amplifier gain calculations
- Converting voltage and power gains to decibels
- Impedance-matching pad calculations
- Interfacing single-ended amplifiers to balanced lines, sources, and loads
- Amplifying device characteristics and applications

70. Audio and RF Circuits 6 hours
Penn Foster Lesson # 086046 Penn Foster Exam # 08604600
- Measuring sound intensity
- AM vs. FM transmission
- Narrow-band FM in industrial applications
- Coaxial cable vs. copper wire transmission mediums
- Tone frequencies used in control systems
- Pushbutton dialing in industrial applications
- Common-emitter amplifiers

71. Oscillators, Feedback, and Waveforms 6 hours
Penn Foster Lesson # 086047 Penn Foster Exam # 08604700
- Oscillator operating principles
- Basic types of oscillators
- Oscillator feedback techniques
- Creating various waveforms
- Phase-locked loop in frequency synthesizers
- Square wave generation utilizing 555 IC circuit timer/oscillator

72. Electronic Power Supply Systems 6 hours
Penn Foster Lesson # 086048 Penn Foster Exam # 08604800
- Function of rectifiers
- Half-wave and full-wave rectifier principles
- Rectifier circuit output voltages
- Percent of voltage regulation in a power supply
- Function of filters and bleeder resistors in power supplies
- Purpose of a voltage-divider network in a power supply
- Electronic voltage regulators
- Common industrial power supplies

73. Industrial Amplification Systems 6 hours
Penn Foster Lesson # 086058 Penn Foster Exam # 08605800
- Power amplifiers vs. voltage amplifiers

- Calculating dB gain
- Characteristics of VMOS, BiFET, Darlington, push-pull, and complementary amplifiers
- Operational amplifier analysis
- Amplifier induced noise and distortion

74. Servo and Control Systems — 6 hours
Penn Foster Lesson # 086059 Penn Foster Exam # 08605900
- Functions and components of a servo system
- Operation of servo systems
- Applications for servo systems
- Electronic circuits in servo applications
- Servo system gain calculations

75. Pulse and Logic Circuits — 6 hours
Penn Foster Lesson # 086060 Penn Foster Exam # 08606000
- Digital vs. analog circuits
- Slow-speed vs. fast-speed digital circuits
- Binary principles in electronic circuits
- Types of logic gates
- Latch and flip-flop circuits
- Serial and parallel inputs/outputs

76. Introduction to Telecommunications Technology — 5 hours
Penn Foster Lesson # Penn Foster Exam # 38781900
- Basic communication system components
- Effect of electrical noise on receivers
- Thermal noise generated by resistors
- Amplifier signal-to-noise ratios and noise figures
- Noise measurement techniques
- Information, bandwidth, and propagation speed relationships
- Fourier analysis of non-sinusoidal repetitive waveforms
- RLC circuit analysis
- LC and crystal oscillators

77. Amplitude Modulation: Transmission — 5 hours
Penn Foster Lesson # Penn Foster Exam # 38782000
- Process of modulation
- AM waveforms and modulation indexes
- Sideband vs. side frequency
- Power, voltage, and current calculations in AM systems
- Basic AM circuits
- High and low level modulation systems
- AM transmitter test and maintenance equipment

78. Amplitude Modulation: Reception — 5 hours

Penn Foster Lesson # Penn Foster Exam # 38782100

- Receiver selectivity and sensitivity
- AM receiver diode detectors
- TRF and superheterodyne receivers
- Image frequencies and how to suppress them
- RF and IF amplifiers
- Implementing Automatic Gain Control
- Analysis of AM receiver systems
- Analysis AM receiver stages

79. Single-Sideband Communications 5 hours
Penn Foster Lesson # Penn Foster Exam # 38782200
- Single sideband generation
- Types of SSB and advantages over AM
- SSB circuits and filters
- SSB filter designs
- Demodulation of SSB systems
- SSB transmitter/receiver block diagrams
- Frequency processing in SSB receivers

80. Frequency Modulation: Transmission 5 hours
Penn Foster Lesson # 387905 Penn Foster Exam # 38790500
- Categories of angle modulation
- Capacitor microphone principles
- FM signal modulation index, sidebands, and power
- FM noise suppression, capture effect , and pre-emphasis
- Generating FM signals
- FM signal generation using phase locked-loop
- Multiplexing techniques for FM stereo systems

81. Frequency Modulation: Reception 5 hours
Penn Foster Lesson # Penn Foster Exam # 38782400
- FM vs. AM receivers
- Slope detector schematics
- FM discriminator techniques and circuits
- Utilizing PLL as an FM descriminator
- Block diagrams for stereo broadcast band receivers
- LIC applications in stereo decoders
- FM receiver schematics

82. Telephone Technology 5 hours
Penn Foster Lesson # 387024 Penn Foster Exam # 38702400
- Components and functions of conventional and electronic telephones and facsimile machines
- Modem modulation techniques
- Components and signals of the local loop
- Telephone system switching mechanisms and hierarchies

- Telephony multiplexing techniques
- Cellular and pager systems

83. Communications Techniques 5 hours
Penn Foster Lesson # Penn Foster Exam # 38782500
- Double conversion and up-conversion
- Delayed AGS and auxiliary AGC
- High quality receivers vs. basic receivers
- Relationships between noise, receiver sensitivity, dynamic range, and 3rd order intercept
- Troubleshooting receivers with excessive IMD
- Frequency synthesizers
- DDS systems vs. analog synthesizers

84. Digital Comm.: Coding Techniques and Transmission 5 hours
Penn Foster Lesson # Penn Foster Exam # 38782600
- Digital transmission bit error rates
- ASCII, EBCDIC, Baudot, and Gray codes
- PCM system operation
- PCM system quantization processes
- PCM vs. delta modulation
- Error detection and correction techniques

85. Network Communications 5 hours
Penn Foster Lesson # 387906 Penn Foster Exam # 38790600
- Telephone network terminology and operation
- Cellular phone systems
- Telephone circuit characteristics
- UART principles of operation
- Modem principles of operation
- Network topologies
- Network protocols
- Ethernet principles of operation
- Cellular and PCS phone system operations

86. Transmission Lines 8 hours
Penn Foster Lesson # Penn Foster Exam # 38781000
- Physical characteristics of standard transmission lines
- Calculating characteristic impedance, delay factor, and velocity of propagation
- Wave propagation and reflection analysis
- Matching loads to transmission lines using a Smith Chart
- Simulating discrete circuitry using short line sections
- Troubleshooting line problems using a TDR

87. Wave Propagation and Antennas 8 hours
Penn Foster Lesson # Penn Foster Exam # 38781100
- Characteristics of electromagnetic waves and isotropic point sources
- Processes of wave reflection, refraction, and diffraction

- Ground and space wave propagation and ghosting phenomena
- Effect of antenna height on effective radio horizon
- Atmospheric effects upon sky-wave propagation
- Skip zone and critical angle influences on sky-wave propagation
- Important aspects of satellite communications
- SATCOM power budget analysis
- Hertz antenna development
- Properties of antenna reciprocity and polarization
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- Antenna performance factors and characteristics

88. Waveguides and Radar 8 hours
Penn Foster Lesson # Penn Foster Exam # 38781200
- Considerations for ending signals via transmission lines, antennas, and waveguides
- Basic modes of operation for rectangular waveguides
- Calculating cutoff wavelength for dominant mode of operation
- Effects of wavelength and velocity upon waveguide propagation
- Various types of waveguides
- Methods of coupling energy into and out of waveguides and cavity resonators
- Basic components and characteristics of a radar system
- Doppler radar system capabilities
- Microstrip and stripline characteristic impedance calculation

89. Microwaves and Lasers 8 hours
Penn Foster Lesson # 086E03 Penn Foster Exam # 38781300
- Common microwave antenna types
- Parabolic antenna gain and beamwidth calculations
- TWT and magnetron microwave tube operation
- Common microwave semiconductor devices
- Basic operation and uses of ferrites
- Operation of parametric and maser low-noise amplifiers
- Basic laser theory of operation

90. Fiber Optics Background Information 5 hours
Penn Foster Lesson # 086950 Penn Foster Exam # 08695002
- Major components of a fiber optic link
- Electronics and fiber optics
- Fiber optics in networks
- Fiber optics vs. traditional transmission media

91. Characteristics of Fiber Optics 5 hours
Penn Foster Lesson # 086951 Penn Foster Exam # 08695102
- Types of fiber
- Dispersion in optical fiber
- Core diameter vs. performance
- Optical fiber applications

- Mode field diameter in single-mode fiber
- Single-mode fiber profiles

92. Sending and Receiving over Fiber 5 hours
Penn Foster Lesson # 086952 Penn Foster Exam # 08695202
- Structure of the atom
- Semiconductor properties
- Electro-optic device principles of operation
- LEDs in fiber optic systems
- Lasers in fiber optic systems
- Fiber optic system output patterns
- Light velocity of propagation
- DFB laser characteristics
- VCSEL characteristics

93. Fiber Optics Interconnections 5 hours
Penn Foster Lesson # 086953 Penn Foster Exam # 08695302
- Optical fiber termination and splicing technology
- Common causes of fiber optic link failures
- Fiber alignment techniques
- Techniques used to terminate optical fiber

94. Fiber Optics Systems 5 hours
Penn Foster Lesson # 086954 Penn Foster Exam # 08695402
- Optical link power budgets
- Bandwidth/rise-time requirements in optical fiber links

95. Fiber Optics Final 5 hours
Penn Foster Lesson # 086956 Penn Foster Exam # 08695602
- Final exam covering fiber optics system hardware and cable

96. Troubleshooting Industrial Computer Systems and Software 6 hours
Penn Foster Lesson # 086068 Penn Foster Exam # 08606800
- Principal parts and types of memory found on a computer motherboard
- Power supply components and ratings
- Locate the main power supply fuse and identify the type of power supply by its connectors
- Various types of computer drive systems and their cables
- Repair and troubleshooting procedures for computer hardware and software problems
- Optical and RF identification systems-operation and troubleshooting
- Purpose of vision system hardware and software and the troubleshooting for them

97. Number and Logic Systems 10 hours
Penn Foster Lesson # 086813 Penn Foster Exam #086918002
- Decimal to binary and binary to decimal conversion
- Binary to octal and octal to binary conversion

- Binary to hexadecimal and hexadecimal to binary conversion
- Decimal to BCD and BCD to decimal conversion

98. Boolean Algebra with OR Gate Application 10 hours
Penn Foster Lesson # 086814 Penn Foster Exam # 086918102
- Reducing Boolean expressions using a Karnaugh map
- Identifying and using DeMorgan's theorems
- Writing truth tables for exclusive-OR gates

99. Adders and Collection Gates 10 hours
Penn Foster Lesson # 086815 Penn Foster Exam # 086918202
- Defining half adders and full adders and drawing block diagrams and truth tables
- Programming GAL devices
- Identifying and calculating fan-out and noise margins
- Using open-collector gates in applications

100. Flip-Flops and Shift Registers 10 hours
Penn Foster Lesson # 086816 Penn Foster Exam # 086918302
- Types of flip-flops (S-R, master-slave, JK and D)
- Application of latches in control circuits
- Configuration of typical IC flip-flops
- Application of flip-flops in shift registers for serial communication devices
- ASCII code and RS-232 standards

101. Counting and Timing Circuits and D/A and A/D Conversion 10 hours
Penn Foster Lesson # 086817 Penn Foster Exam # 086918402
- Understanding and explaining the operation of a variety of binary counters
- Applications of synchronous and asynchronous counters in frequency dividing
- Generation and application of clock pulses in computers and digital electronic equipment

102. Digital Electronic Applications 10 hours
Penn Foster Lesson # 086818 Penn Foster Exam # 086918502
- Operation and function of decoders, multiplexers, and de-multiplexers
- Operation and application of LEDs and other digital displays
- Operation and application of gates and other devices with tri-state outputs
- Using digital outputs to drive high-current transistor interfaces
- Devices that isolate circuits from each other
- Applications of various types of memory
- Basic concepts and structures of microcomputers and microcontrollers

Supplemental Training Hours	
Year 1	161
Year 2	148
Year 3	144
Year 4	178
Total Hours	631

Apprentice Communications Technician (D805 - Job Class 7653)

Section K. Wages

Wage Schedule for Apprentice Communications 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.