

Electrical

The Electrical Apprenticeship at TOCC is based on a curriculum developed by the National Center for Construction Education & Research (NCCER), whose website is www.nccer.org. The following tables show the content of classroom instruction and the number of hours of instruction for each

module. Following the tables are descriptions of the modules. Classroom instruction is complemented by on-the-job training, which is customized for each student. Electrical is a four-year program, requiring 8,000 hours of time invested by the student.

First Year (200 hours)

FIRST SEMESTER (Core)	Hours	SECOND SEMESTER	Hours
Basic Safety	15	Electrical Safety	12.5
Introduction to Construction Math	15	Hand Bending	7.5
Introduction to Hand Tools	10	Fasteners & Anchors	5
Introduction to Power Tools	5	Electrical Theory One	7.5
Introduction to Blueprints	7.5	Electrical Theory Two	7.5
Basic Rigging	20	Electrical Test Equipment	7.5
Basic Communication Skills	5	Introduction to The National Electrical Code	2.5
Basic Employability Skills	15	Raceways, Boxes & Fittings	12.5
		Conductors	15
		Introduction to Electrical Blueprints	7.5
		Wiring: Commercial and Industrial	7.5
		Wiring: Residential	15
Total Semester Hours	92.5	Total Semester Hours	107.5

Second Year (152.5 hours)

FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
Alternating Current	15	Cable Tray	15
Motors: Theory & Application	20	Conductor Termination and Splices	7.5
Grounding	12.5	Installation of Electric Services	15
Conduit Bending	15	Circuit Breakers & Fuses	12.5
Boxes & Fittings	10	Contactors & Relays	10
Conductor Installations	10	Electric Lighting	10
Total Semester Hours	82.5	Total Semester Hours	70

Third Year (155 hours)

FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
Load Calculation: Branch Feeders & Circuits	12.5	Distribution System Transformer	15
Conductor Selection & Calculation	15	Lamps, Ballasts, and Components	5
Over current Protection	12.5	Motor Calculations	12.5
Raceway, Box, and Fittings	12.5	Motor Maintenance, part one	12.5
Wiring Devices	10	Motor Controls	20
Distribution Equipment	12.5	Hazardous Locations	15
Total Semester Hours	75	Total Semester Hours	80

Fourth Year (160 hours)

FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
Load Calculations (feeders and services)	15	Special Transformers	15
Practical Application of Lighting	10	Advanced Motor Controls	20
Standby and Emergency Systems	20	HVAC Controls	15
Basic Electronic Theory	20	Heat Tracing and Freeze Protection	10
Fire Alarm Systems	20	Motor Maintenance, Part Two	12.5
		High-Voltage Terminations/Splices	10
Total Semester Hours	77.5	Total Semester Hours	82.5

Total Apprenticeship-Related Training (Classroom Instruction) = 667.5 hours

Electrical Modules

First Year (200 hours)

First Semester (92.5 hours)

Basic Safety (15 hours) Explains the safety obligations of workers, supervisors, and managers to ensure a safe workplace. Discusses the causes and results of accidents and the dangers of rationalizing risk. Reviews the role of company policies and OSHA regulations in maintaining a safe workplace. Introduces common job-site hazards and protections such as lockout/tagout, personal protective equipment (PPE), and HazCom.

Introduction to Construction Math (15 hours)

Reviews basic mathematical functions such as adding, subtracting, dividing, and multiplying whole numbers, fractions, and decimals, and explains their applications to the construction trades. Explains decimal-fraction conversions and the metric system using practical examples. Also reviews basic geometry as applied to common shapes and forms.

Introduction to Hand Tools (10 hours)

Introduces trainees to hand tools that are widely used in the construction industry, such as hammers, saws, levels, pullers, vises, and clamps. Explains the specific applications of each tool and shows how to use them properly. Also discusses important safety and maintenance issues related to hand tools.

Introduction to Power Tools (5 hours)

Provides detailed descriptions of commonly used power tools such as drills, saws, grinders, and sanders. Reviews applications, proper use, safety, and maintenance. Many illustrations show power tools used in on-the-job settings.

Introduction to Blueprints (7.5 hours)

Familiarizes trainees with basic blueprint terms, components, and symbols. Explains the different types of blueprint drawings (civil, architectural, structural, mechanical, plumbing/piping, and electrical) and instructs trainees on how to

interpret and use drawing dimensions. Two oversized drawings are included.

Basic Rigging (20 Elective hours) Explains how ropes, chains, hoists, loaders, and cranes are used to move material and equipment from one location to another on a job site. Describes inspection techniques and load-handling safety practices. Also reviews American National Standards Institute (ANSI) hand signals.

Basic Communication Skills (5 Elective hours)

Provides trainees with techniques for communicating effectively with co-workers and supervisors. Includes practical examples that emphasize the importance of verbal and written information and instructions on the job. Also discusses effective telephone and e-mail communication skills.

Basic Employability Skills (15 Elective hours; Must be combined with 00107-04)

Identifies the roles of individuals and companies in the construction industry. Introduces trainees to critical thinking and problem solving skills and computer systems and their industry applications. Also reviews effective relationship skills, effective self-presentation, and key workplace issues such as sexual harassment, stress, and substance abuse.

Second Semester (107.5 hours)

Electrical Safety (12.5 hours)

Covers safety rules and regulations for electricians. Trainees learn the necessary precautions to take for various electrical hazards found on the job. Also teaches the OSHA-mandated lockout/tagout procedure.

Hand Bending (7.5 hours)

Provides an introduction to conduit bending and installation. Covers the techniques for using hand-operated and step conduit benders, as well as cutting, reaming, and threading conduit.

Fasteners and Anchors (5 hours)

Covers the hardware and systems used by an electrician to mount and support boxes, receptacles, and other electrical components. Trainees learn the various

types of anchors and supports, their applications, and safe installation.

Electrical Theory One (7.5 hours) Offers a general introduction to the electrical concepts used in Ohm's law applied to DC series circuits. Includes atomic theory, electromotive force, resistance, and electric power equations.

Electrical Theory Two (7.5 hours) Introduces series, parallel, and series-parallel circuits. Covers resistive circuits, Kirchoff's voltage and current laws, and circuit analysis.

Electrical Test Equipment (7.5 hours) Focuses on proper selection, inspection, use, and maintenance of common electrical test equipment. Trainees get to practice using many of the instruments while learning the appropriate test procedures and safety rules.

Introduction to the National Electrical Code® (2.5 hours) Provides a navigational road map for using the NEC®. Trainees are introduced to the layout of the NEC® and the types of information found within the code book. Trainees are able to practice finding information using an easy-to-follow procedure.

Raceways, Boxes, and Fittings (12.5 hours) Introduces the types and applications of raceways, wireways, and ducts. The appropriate NEC® requirements are stressed.

Conductors (15 hours) Focuses on the types and applications of conductors and covers proper wiring techniques. The appropriate NEC® requirements are stressed.

Introduction to Electrical Blueprints (7.5 hours) Focuses on electrical prints, drawings, and symbols. Trainees learn the types of information they can find on schematics, one-lines, and wiring diagrams.

Commercial and Industrial (7.5 hours) Covers the electrical devices and wiring techniques common to commercial and industrial construction and maintenance. The appropriate NEC® requirements are stressed.

Wiring: Residential (15 hours) Covers the electrical devices and wiring techniques common to residential construction and maintenance. Trainees also practice making service calculations. Stresses appropriate NEC® requirements.

Second Year (152.5 hours)

First Semester (82.5 hours)

Alternating Current (15 hours) Focuses on forces that are characteristic of alternating-current systems and the Application of Ohm's law to AC circuits.

Motors: Theory and Application (20 hours) Covers AC and DC motors including the main parts, circuits, and connections.

Grounding (12.5 hours) Focuses on the purpose of grounding and bonding electrical systems. NEC® regulations are thoroughly covered.

Conduit Bending (15 hours) Covers all types of bends in all sizes of conduit up to 6 inches. Focus is placed on mechanical, hydraulic, and electrical benders.

Boxes and Fittings (10 hours) An NEC®-driven module that explains how to select and size outlet boxes, pull boxes, and junction boxes.

Conductor Installations (10 hours) Covers the transportation, storage, and setup of cable reels; methods of rigging; and procedures for complete cable pulls in raceways and cable trays.

Cable Tray (15 hours) Focuses on NEMA and NEC® installation requirements for cable tray, including modifications and cable installations.

Conductor Terminations and Splices (7.5 hours) Describes methods of terminating and splicing conductors of all types and sizes, including the preparation and taping of conductors.

Second Semester (70 hours)

Installation of Electric Services (15 hours) Covers methods and techniques for both single- and three-phase services, including metering equipment and NEC® regulations.

Circuit Breakers and Fuses (12.5 hours) Describes fuses and circuit breakers along with their practical applications. Short-circuit calculation is also covered.

Contactors and Relays (10 hours) Gives basic descriptions of various types of contactors and relays, along with their practical applications.

Electric Lighting (10 hours) Introduces the basic principles of human vision and the characteristics of light. Focuses on the handling and installation of the different kinds of lamps (incandescent, fluorescent, and HID) and lighting fixtures (surface-mounted, recessed, suspended, and track lighting).

Third Year (155 hours)

First Semester (75 hours)

Load Calculations – Branch Circuits (12.5 hours) Introduces the industry standards for electrical work, including the topics of branch circuits, rating and derating, and various types of residential and commercial electrical loads.

Conductor Selection and Calculations (15 hours) Covers the types of conductors used in wiring systems, including insulation, current-carrying capacity, and temperature ratings.

Overcurrent Protection (12.5 hours) Stresses the use of a variety of overcurrent protection devices, including circuit breakers and fuses, in all types of electrical systems.

Raceway, Box, and Fitting Fill Requirements (12.5 hours) Covers the number of conductors allowed in raceways, boxes, and fittings.

Wiring Devices (10 hours) Covers popular

receptacles and switches, and takes an in-depth look at safety switches and other wiring devices.

Distribution Equipment (12.5 hours) Explains distribution equipment, including grounding, switchboard and ground fault maintenance, transformers, and electrical drawing identification.

Second Semester (80 hours)

Distribution System Transformers (15 hours) Discusses transformer types, construction, connections, protection, and grounding along with capacitors and rectifiers.

Lamps, Ballasts, and Components (5 hours) Covers specific types of incandescent, fluorescent, and HID lamps, as well as ballasts, troubleshooting, and various types of lighting controls.

Motor Calculations (12.5 hours) Covers single and multi-motor calculations to enable the trainee to size conductors, overcurrent protection, and overload protection for motor applications.

Motor Maintenance, Part One (12.5 hours) Covers proper maintenance of motors in use and in storage. Includes a troubleshooting and motor identification guide.

Motor Controls (20 hours) Provides information on selecting, sizing, and installing motor controllers. Also covers control circuit pilot devices and basic relay logic.

Hazardous Locations (15 hours) All classes of hazardous locations are covered, including seals, components, and equipment approved for use in various hazardous locations.

Fourth Year (160 hours)

First Semester (77.5 hours)

Load Calculations – Feeders and Services (15 hours) Topics include basic calculation procedures and Calculations for commercial and residential applications.

Practical Applications of Lighting (10 hours)

Covers various lighting installations, applications, and wiring systems.

Standby and Emergency Systems (12.5 hours)

NEC® installation requirements for electric generators and storage batteries are fully explained.

Basic Electronic Theory (20 hours) Explains the function and operation of basic electronic devices, including semiconductors, diodes, rectifiers, and transistors.

Fire Alarm Systems (15 hours) Covers fire alarm control units, Digital Alarm Communicator Systems (DACS), installation wiring for alarm initiating and notification devices, and alarm system maintenance.

Second Semester (82.5 hours)

Specialty Transformers (15 hours) Covers various types of transformers and their applications. Also provides information on selecting, sizing, and installing these devices.

Advanced Motor Controls (20 hours) Explains applications and operating principles of solid-state controls, reduced-voltage starters, and adjustable frequency drives. Also covers basic troubleshooting procedures.

HVAC Controls (15 hours) Provides a basic overview of HVAC systems and their controls. Stresses electrical trouble-shooting and NEC® requirements.

Heat Tracing and Freeze Protection (10 hours) Covers various heat tracing systems along with their applications and installation requirements.

Motor Maintenance, Part Two (12.5 hours) Covers motor cleaning, testing, and preventative maintenance. Also describes basic troubleshooting procedures.

High-Voltage Terminations/Splices (10 hours) Offers an overview of the NEC® and cable manufacturers' requirements for high voltage terminations and splices.