

# Electrical Systems Technology

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This curriculum is designed to provide training for persons interested in installing and maintaining electrical systems found in residential, commercial, and industrial facilities. The Electrical Systems Technology (EST) curriculum is separated into three categories: Solar, Design, and Manufacturing Automation Troubleshooting/Maintenance. The solar degree prepares graduates for a career in installation, electrical code (NEC), maintenance, and solar equipment design on a residential, commercial or larger industry level. The design degree prepares graduates for a career in installing, designing, estimating, or testing residential, commercial, and industrial fields. The electrical manufacturing maintenance degree prepares graduates for a career in industries that require machine electrical repair skills on industrial and manufacturing machinery.

Coursework, most of which is hands-on, includes AC/DC theory, basic wiring practices, programmable logic controllers, industrial motor controls, applications of the National Electric Code, and other subjects, as local needs require.

The program offers various certificates that focus on courses to specialize in solar, residential, industrial, and manufacturing maintenance. Students also may complete certificate programs in HVAC controls and HVAC facilities maintenance, which are integrated within the Air Conditioning, Heating, and Refrigeration program.

For specific information about potential positions and wages in electrical systems technology, visit the Central Piedmont Career Coach website.

**ELC 111. Introduction to Electricity. 3.0 Credits.** Class-2.0. Clinical-0.0. Lab-2.0. Work-0.0

This course introduces the fundamental concepts of electricity and test equipment to non-electrical/electronics majors. Topics include basic DC and AC principles (voltage, resistance, current, impedance); components (resistors, inductors, and capacitors); power; and operation of test equipment. Upon completion, students should be able to construct and analyze simple DC and AC circuits using electrical test equipment.

**ELC 112. DC/AC Electricity. 5.0 Credits.** Class-3.0. Clinical-0.0. Lab-6.0. Work-0.0

This course introduces the fundamental concepts of and computations related to DC/AC electricity. Emphasis is placed on DC/AC circuits, components, operation of test equipment; and other related topics. Upon completion, students should be able to construct, verify, and analyze simple DC/AC circuits.

**ELC 113. Residential Wiring. 4.0 Credits.** Class-2.0. Clinical-0.0. Lab-6.0. Work-0.0

This course introduces the care/usage of tools and materials used in residential electrical installations and the requirements of the National Electrical Code. Topics include NEC, electrical safety, and electrical print reading; planning, layout; and installation of electrical distribution equipment; lighting; overcurrent protection; conductors; branch circuits; and conduits. Upon completion, students should be able to properly install conduits, wiring, and electrical distribution equipment associated with residential electrical installations.

**ELC 114. Commercial Wiring. 4.0 Credits.** Class-2.0. Clinical-0.0. Lab-6.0. Work-0.0

This course provides instruction in the application of electrical tools, materials, and test equipment associated with commercial electrical installations. Topics include the NEC; safety; electrical blueprints; planning, layout, and installation of equipment and conduits; and wiring devices such as panels and overcurrent devices. Upon completion, students should be able to properly install equipment and conduit associated with commercial electrical installations.

**ELC 115. Industrial Wiring. 4.0 Credits.** Class-2.0. Clinical-0.0. Lab-6.0. Work-0.0

This course covers layout, planning, and installation of wiring systems in industrial facilities. Emphasis is placed on industrial wiring methods and materials. Upon completion, students should be able to install industrial systems and equipment.

**ELC 117. Motors and Controls. 4.0 Credits.** Class-2.0. Clinical-0.0. Lab-6.0. Work-0.0

This course introduces the fundamental concepts of motors and motor controls. Topics include ladder diagrams, pilot devices, contactors, motor starters, motors, and other control devices. Upon completion, students should be able to properly select, connect, and troubleshoot motors and control circuits.

**ELC 118. National Electrical Code. 2.0 Credits.** Class-1.0. Clinical-0.0. Lab-2.0. Work-0.0

This course covers the use of the current National Electrical Code. Topics include the NEC history, wiring methods, overcurrent protection, materials, and other related topics. Upon completion, students should be able to effectively use the NEC.

**ELC 119. NEC Calculations. 2.0 Credits.** Class-1.0. Clinical-0.0. Lab-2.0. Work-0.0

This course covers branch circuit, feeder, and service calculations. Emphasis is placed on sections of the National Electrical Code related to calculations. Upon completion, students should be able to use appropriate code sections to size wire, conduit, and overcurrent devices for branch circuits, feeders, and service.

**ELC 121. Electrical Estimating. 2.0 Credits.** Class-1.0. Clinical-0.0. Lab-2.0. Work-0.0

This course covers the principles involved in estimating electrical projects. Topics include take-offs of materials and equipment, labor, overhead, and profit. Upon completion, students should be able to estimate simple electrical projects.

**ELC 125. Diagrams and Schematics. 2.0 Credits.** Class-1.0. Clinical-0.0. Lab-2.0. Work-0.0

This course covers the interpretation of electrical diagrams, schematics, and drawings common to electrical applications. Emphasis is placed on reading and interpreting electrical diagrams and schematics. Upon completion, students should be able to read and interpret electrical diagrams and schematics.

**ELC 127. Software for Technicians. 2.0 Credits.** Class-1.0. Clinical-0.0. Lab-3.0. Work-0.0

This course introduces computer software which can be used to solve electrical/electronics problems. Topics include electrical/electronics calculations and applications. Upon completion, students should be able to utilize a personal computer for electrical/electronics-related applications.

**ELC 128. Introduction to Programmable Logic Controller. 3.0 Credits.** Class-2.0. Clinical-0.0. Lab-3.0. Work-0.0

This course introduces the programmable logic controller (PLC) and its associated applications. Topics include ladder logic diagrams, input/output modules, power supplies, surge protection, selection/installation of controllers, and interfacing of controllers with equipment. Upon completion, students should be able to understand basic PLC systems and create simple programs.

**ELC 130. Advanced Motors and Controls. 3.0 Credits.** Class-2.0. Clinical-0.0. Lab-2.0. Work-0.0

This course covers motors concepts, construction and characteristics and provides a foundation in motor controls. Topics include motor control ladder logic, starters, timers, overload protection, braking, reduced voltage starting, SCR control, AC/DC drives, system and component level troubleshooting. Upon completion, students should be able to specify, connect, control, troubleshoot, and maintain motors and motor control systems.

Prerequisites: Take One: ELC 111, ELC 112, ELC 131, or ELC 138

**ELC 131. Circuit Analysis I. 4.0 Credits.** Class-3.0. Clinical-0.0. Lab-3.0. Work-0.0

This course introduces DC and AC electricity with an emphasis on circuit analysis, measurements, and operation of test equipment. Topics include DC and AC principles, circuit analysis laws and theorems, components, test equipment operation, circuit simulation, and other related topics. Upon completion, students should be able to interpret circuit schematics; design, construct, verify, and analyze DC/AC circuits; and properly use test equipment.

Corequisites: Take MAT 121 or MAT 171

**ELC 133. Circuit Analysis II. 4.0 Credits.** Class-3.0. Clinical-0.0. Lab-3.0. Work-0.0

This course covers additional concepts of DC/AC electricity, the use of test equipment, and measurement techniques. Topics include the application of network theorems such as delta/wye transformations, Superposition Theorem, and other advanced circuit analysis principles. Upon completion, students should be able to construct and analyze DC/AC circuits used advanced circuit analysis theorems, circuit simulators, and test equipment.

Prerequisites: Take ELC 131, minimum grade of C

**ELC 135. Electrical Machines. 3.0 Credits.** Class-2.0. Clinical-0.0. Lab-2.0. Work-0.0

This course covers magnetic circuits, transformers, DC/AC machines, and the three-phase circuit fundamentals including power factor. Topics include magnetic terms and calculations, transformer calculations based on primary or secondary equivalent circuits, and regulation and efficiency calculations. Upon completion, students should be able to perform regulation and efficiency calculations for DC/AC machine circuits.

Prerequisites: Take ELC 131, minimum grade of C

**ELC 136. Electrical Machines II. 4.0 Credits.** Class-3.0. Clinical-0.0. Lab-3.0. Work-0.0

This course covers DC/AC machine fundamentals including applications and control. Topics include control devices and induction single and polyphase AC motors, DC motors, stepper, and special purpose motors. Upon completion, students should be able to perform regulation and efficiency calculations and apply motor theory to practical control applications.

Prerequisites: Take ELC 135, minimum grade of C

**ELC 138. DC Circuit Analysis. 4.0 Credits.** Class-3.0. Clinical-0.0. Lab-3.0. Work-0.0

This course introduces DC electricity with an emphasis on circuit analysis, measurements, and operation of test equipment. Topics include DC principles, circuit analysis laws and theorems, components, test equipment operation, circuit simulation, and other related topics. Upon completion, students should be able to interpret circuit schematics; design, construct, and analyze DC circuits; and properly use test equipment.

**ELC 139. AC Circuit Analysis. 4.0 Credits.** Class-3.0. Clinical-0.0. Lab-3.0. Work-0.0

This course introduces AC electricity with an emphasis on circuit analysis, measurements, and operation of test equipment. Topics include AC voltages, circuit analysis laws and theorems, reactive components and circuits, transformers, test equipment operation, circuit simulation, and other related topics. Upon completion, students should be able to interpret AC circuit schematics; analyze and troubleshoot AC circuits; and properly use test equipment.

Prerequisites: Take ELC 138

**ELC 213. Instrumentation. 4.0 Credits.** Class-3.0. Clinical-0.0. Lab-2.0. Work-0.0

This course covers the fundamentals of instrumentation used in industry. Emphasis is placed on electric, electronic, and other instruments. Upon completion, students should be able to install, maintain, and calibrate instrumentation.

Prerequisites: Take ELC 131, minimum grade of C

**ELC 215. Electrical Maintenance. 3.0 Credits.** Class-2.0. Clinical-0.0. Lab-3.0. Work-0.0

This course introduces the theory of maintenance and the skills necessary to maintain electrical equipment found in industrial and commercial facilities. Topics include maintenance theory, predictive and preventive maintenance, electrical equipment operation and maintenance, and maintenance documentation. Upon completion, students should be able to perform maintenance on electrical equipment in industrial and commercial facilities.

**ELC 220. Photovoltaic System Technology. 3.0 Credits.** Class-2.0. Clinical-0.0. Lab-3.0. Work-0.0

This course introduces the concepts, tools, techniques, and materials needed to understand systems that convert solar energy into electricity with photovoltaic (pv) technologies. Topics include site analysis for system integration, building codes, and advances in photovoltaic technology. Upon completion, students should be able to demonstrate an understanding of the principles of photovoltaic technology and current applications.

**ELC 221. Advanced Photovoltaic System Designs. 3.0 Credits.**

Class-2.0. Clinical-0.0. Lab-3.0. Work-0.0

This course introduces specific elements in photovoltaic (pv) systems technologies including efficiency, modules, inverters, charge controllers, batteries, and system installation. Topics include National Electrical Code (NEC), electrical specifications, photovoltaic system components, array design and power integration requirements that combine to form a unified structure. Upon completion, students should be able to demonstrate an understanding of various photovoltaic designs and proper installation of NEC compliant solar electric power systems.

Prerequisites: Take ELC 220

**ELC 228. Programmable Logic Controllers Applications. 4.0 Credits.**

Class-2.0. Clinical-0.0. Lab-6.0. Work-0.0

This course covers programming and applications of programmable logic controllers. Emphasis is placed on programming techniques, networking, specialty I/O modules, and system troubleshooting. Upon completion, students should be able to specify, implement, and maintain complex PLC controlled systems.

**ELC 229. Applications Project. 2.0 Credits.** Class-1.0. Clinical-0.0.

Lab-3.0. Work-0.0

This course provides an individual and/or integrated team approach to a practical project as approved by the instructor. Topics include project selection and planning, implementation and testing, and a final presentation. Upon completion, students should be able to plan and implement an applications-oriented project.

**ELC 230. Wind and Hydro Power Systems. 3.0 Credits.** Class-2.0.

Clinical-0.0. Lab-2.0. Work-0.0

This course introduces concepts, designs, tools, techniques, and material requirements for systems that convert wind and water into usable energy. Topics include the analysis, measurement, and estimation of potential energy of wind and water systems. Upon completion, students should be able to demonstrate an understanding of the technologies associated with converting wind and water into a viable energy source.

**ELC 231. Electric Power Systems. 4.0 Credits.** Class-3.0. Clinical-0.0.

Lab-2.0. Work-0.0

This course covers the basic principles of electric power systems, including transmission lines, generator and transformer characteristics, and fault detection and correction. Emphasis is placed on line diagrams and per unit calculations for circuit performance analysis in regards to voltage regulation, power factor, and protection devices. Upon completion, students should be able to analyze simple distribution subsystems, calculate fault current, and compare different types and sizes of circuit protection devices.

Prerequisites: Take ELC 135, minimum grade of C

**ELC 233. Energy Management. 3.0 Credits.** Class-2.0. Clinical-0.0.

Lab-2.0. Work-0.0

This course covers energy management principles and techniques typical of those found in industry and commercial facilities, including load control and peak demand reduction systems. Topics include load and peak demand calculations, load shedding, load balance and power factor, priority scheduling, remote sensing and control, and supplementary/alternative energy sources. Upon completion, students should be able to determine energy management parameters, calculate demand and energy use, propose energy management procedures, and implement alternative energy sources.

Corequisites: Take ELC 131

**ELC 234. Electrical System Design. 3.0 Credits.** Class-2.0. Clinical-0.0.

Lab-3.0. Work-0.0

This course introduces the principles of electrical design for commercial and industrial facilities. Topics include services, high and low power distribution, switchboards, panelboards, motor control centers, switchgear, overcurrent protection, and grounding. Upon completion, students should be able to design services, feeders, and branch circuits for typical commercial/industrial applications in accordance with the National Electrical Code.