



# Electrician (Construction & Maintenance)

*Apprenticeship Program*



## PROGRAM DESCRIPTION

This provincially approved apprenticeship certificate program is designed to provide students with the theoretical principles and trade skills necessary for careers as electricians. The program also fulfills the in-school requirements of the Provincial Construction and Maintenance Electrician apprenticeship program. Students who work well with others, have a good educational background, and an aptitude in mechanics have an excellent chance of succeeding in this field. A strong sense of responsibility is also important.

The in-school portion of the program consists of one eight-week level for Basic followed by two 10-week portions at the Intermediate and Advanced levels during which students attend classes 30 hours per week. In the basic, intermediate, and advanced levels, students take courses in prints and standards, electrical principles, practical installations, and electronics. Students work in a variety of specialty areas throughout the three levels. Students spend approximately one-half of their time in the campus laboratories acquiring practical, hands-on experience.

While a grade 10 education has long been the minimum entry requirement for an Electrical Apprentice, the level of education required for success in our electrical industry is ever increasing. It is strongly recommended, therefore, that, to help ensure student success, the Electrical Apprentice enter the in-school training program with a minimum equivalent of grade 12 physics, chemistry, communications, and mathematics.

## EMPLOYMENT OPPORTUNITIES

Graduates may find employment as electricians working closely with every trade area, including millwrights, heating and refrigeration technicians, stationary engineers, and instrumentation technicians.

## ADDITIONAL INFORMATION

This full-time apprenticeship program is offered on the Woodroffe Campus. For more information, please contact the program co-ordinator Andy Vandesande at (613) 727-4723 ext. 5480.

## PROGRAM OF STUDY

*Programs at Algonquin College are delivered using a variety of instruction modes. Courses may be offered in the classroom or lab, entirely on-line, or in a hybrid mode which combines classroom sessions with on-line learning activities. Upon registration, each full-time student is provided an Algonquin e-mail account which is used to communicate important information about program or course events.*

### Level: 01 (Basic) Hours

ELE8711	CANADIAN ELECTRICAL CODE - LEVEL 1	33.0
ELE8712	PRINTS - LEVEL 1	30.0
ELE8713	ELECTRICAL THEORY - LEVEL 1	63.0
ELE8714	INSTALLATION METHODS - LEVEL 1	48.0
ELE8715	INSTALLATION - LEVEL 1	24.0
ELE8716	ELECTRONICS - LEVEL 1	42.0

### Level: 02 (Intermediate) Hours

ELE8721	CANADIAN ELECTRICAL CODE - LEVEL 2	39.0
ELE8722	PRINTS - LEVEL 2	30.0
ELE8723	ELECTRICAL THEORY - LEVEL 2	81.0
ELE8724	INSTALLATION METHODS - LEVEL 2	39.0
ELE8725	INSTALLATION - LEVEL 2	42.0
ELE8726	ELECTRONICS - LEVEL 2	39.0
ELE8727	MONITORING AND COMMUNICATION SYSTEMS - LEVEL 2	30.0

### Level: 03 (Advanced) Hours

ELE8731	CANADIAN ELECTRICAL CODE - LEVEL 3	30.0
ELE8732	PRINTS - LEVEL 3	30.0
ELE8733	ELECTRICAL THEORY - LEVEL 3	60.0
ELE8734	INSTALLATION METHODS - LEVEL 3	81.0
ELE8735	INSTALLATION - LEVEL 3	39.0
ELE8737	ELECTRONICS - LEVEL 3	60.0

## ADMISSION REQUIREMENTS

### Program Eligibility

- Applicants must be formally registered as apprentices; must be currently employed in the trade; and must be released by employers to attend the College.
- Eligibility is determined by the Ministry of Training, Colleges and Universities; Apprenticeship and Client Services.

## FEES AND EXPENSES

Tuition Fees listed are for the 2006-2007 academic year.  
 Tuition Fees: \$400.00 for level 01, and \$500.00 for levels 02 and 03.  
 Information Technology Fees: \$25.00 per term for level 01 and \$31.25 per term for levels 02 and 03.\*  
 \* Students paying the Information Technology fee are provided with a network account, modem account, an e-mail address, Internet access. For more information please visit our web site at [www.algonquincollege.com/its/services/ti\\_fee.htm](http://www.algonquincollege.com/its/services/ti_fee.htm)  
 Learning materials are available at Algonquin College. Students are responsible for supplies, including safety footwear, and for parking and locker fees, if applicable.

*This brochure reflects the most current information available at the time of publication, July 2006. Modifications may be made prior to the start of classes. Should there be insufficient enrolment, the College reserves the right to suspend any program, option or choice. For the most up-to-date information, please visit our website at [www.algonquincollege.com](http://www.algonquincollege.com)*

## APPLICATION INFORMATION

### ELECTRICIAN (CONSTRUCTION AND MAINTENANCE)

#### Program Code 0506X01FWO

Registration for Apprenticeship programs takes place through the Ministry of Training, Colleges and Universities, Apprenticeship and Client Services Branch. For further information, please contact:

Ministry of Training, Colleges and Universities  
Apprenticeship and Client Services Branch  
Ottawa District Office  
1355 Bank Street Suite 703  
Ottawa, Ontario K1H 8K7  
(613) 731-7100

## COURSE DESCRIPTIONS

### ELE8711 CANADIAN ELECTRICAL CODE - LEVEL 1

Upon successful completion, the apprentice is able to apply the requirements of the Canadian Electrical Code - Part 1 (CEC) to identify and interpret the general requirements of the CEC; identify and interpret the CEC requirements for conductor ampacity including free air, above and underground installations, grounding and bonding, wiring methods, class 1 and 2 circuits, receptacles and lighting in residential occupancies, single-dwelling and dwelling units, pools, tubs and spas, and temporary installations; and be able to calculate the service requirements for a residential occupancy, single-dwelling and row-housing.

### ELE8712 PRINTS - LEVEL 1

Upon successful completion, the apprentice is able to identify and interpret the alpha numerical lines; use the metric and imperial scales and be able to convert between them; obtain information from architectural, structural and mechanical drawings, specifications, building code and CEC to complete an electrical installation for a single-dwelling; draw and label a panel schematic for a single-dwelling; and complete a material take-off for a single-dwelling.

### ELE8713 ELECTRICAL THEORY - LEVEL 1

Upon successful completion, the apprentice is able to understand electron theory; define voltage, current and resistance, as well as electrical and mechanical power and energy; describe the effects of electricity on the human body; explain the principles of common sources of Electro-Motive Force (EMF); and to analyze series, parallel and combination DC circuits by applying Ohm's Law and Kirchoff's Laws; describe magnetic lines of force and list their characteristics; describe the relationship between magnetism and EMF.

### ELE8714 INSTALLATION METHODS - LEVEL 1

Upon successful completion, the apprentice is able to demonstrate the operation of common hand and power tools; install common switching devices, outlets and enclosures; correctly terminate conductors; demonstrate the installation procedures for non-metallic sheathed cable, armoured cable, mineral insulated cable, rigid conduits, flexible conduits, liquid-tight conduit, electrical metallic tubing, and electrical non-metallic tubing, including supports and tools required; install a 100 amp. residential consumer's service and associated branch circuits; layout a service mast installation; install door, signal and extra-low voltage lighting devices; identify and terminate copper communication and hard wired cables.

### ELE8715 INSTRUMENTATION - LEVEL 1

Upon successful completion, the apprentice is able to explain common terms used in instrumentation systems; work with the SI and Imperial system of measurement for pressure and temperature; convert between the four temperature scales; describe the operation, applications and limitations of thermocouples, thermistors, and RTD's; install, connect, and test thermocouples, thermistors, and RTD's; identify deformation elements of pressuring measuring equipment; determine the accuracy of pressure measuring equipment; explain relationships between gauge and absolute pressure, and vacuum; explain the operation, construction and applications of typical industrial pressure sensors; Identify ISA instrumentation symbols and draw basic process (P) and Instrumentation (I) diagrams for pressure and temperature devices; explain the operation of light and sound meters.

### ELE8716 ELECTRONICS - LEVEL 1

Upon successful completion, the apprentice is able to identify schematic symbols for North American and European basic logic gates; describe the operation of basic logic gates; use basic logic gates to create digital logic circuits; state Boolean equations for simple logic gates; design and test combination logic circuits; describe the voltage requirements for TTL and CMOS logic circuits; demonstrate the use of R.S. and D type flip-flop; use a logic probe to troubleshoot a digital circuit; demonstrate procedures for soldering and de-soldering; state the standard resistor colour code; connect resistors in series, parallel and combination circuits; describe the properties of N and P type semiconductor materials; explain current, voltage and biasing requirements for silicon and germanium diodes, and LED's demonstrate the operation of a bipolar diode; identify the symbols for and describe the operation and biasing for NPN and PNP Bipolar transistors; demonstrate how a transistor can be used as a switch; demonstrate the common applications for an opto-coupler.

### ELE8721 CANADIAN ELECTRICAL CODE - LEVEL 2

Upon successful completion, the apprentice is able to: interpret the CEC requirements pertaining to the installations for: interior and exterior lighting systems; fire alarms and fire pumps, emergency systems, unit equipment and exit signs; fuses, circuit breakers and ground fault protection and control devices; equipment in hazardous locations; hospitals and patient care areas; storage batteries; individual continuous and non-continuous duty service motors; and to calculate conductor and overcurrent device sizes required for specific continuous and non-continuous loads and the minimum ampacity of conductors and overcurrent devices for apartment and similar buildings.

### ELE8722 PRINTS - LEVEL 2

Upon successful completion, the apprentice is able to: determine utility location and site features using site drawings; determine methods of construction using architectural and structural drawings; determine the electrical characteristics and layout of mechanical equipment and systems; lay out commercial distribution and service equipment and wiring; lay out branch circuit for lighting and equipment; prepare a material take off using drawings, specifications; prepare sketches to solve and document construction problems and solutions; prepare as-built drawings; and develop basic single line, schematic, and wiring diagrams.

### ELE8723 ELECTRICAL THEORY - LEVEL 2

Upon successful completion, the apprentice is able to: describe magnetic flux and flux density; solve problems associated with magnetic energy; explain Ohm's Law as applied to magnetic circuits; describe factors which affect inductance and perform related calculations; apply Fleming's hand rules and Lenz's law; describe the types, construction, operation and characteristics of DC machines; describe a sine wave; calculate RMS, average, maximum, and instantaneous values; calculate frequency, electrical and mechanical degrees; calculate phasors, vectors and vector diagrams; describe the effects of alternating voltage and current in a resistive device; calculate inductive reactance, voltage, current, and power of an inductive circuit; calculate capacitive reactance, voltage, current, power and phase relationships of a capacitive circuit; calculate values for RL/RC/RLC series and parallel circuits; and calculate resonant circuits.

### ELE8724 INSTALLATION METHODS - LEVEL 2

Upon successful completion, the apprentice is able to: identify the mechanical parts, windings and wiring connections of DC machines; demonstrate manual and magnetic across-the-line starting techniques for motors; demonstrate methods for forward-reverse control of motors; demonstrate reduced voltage starting techniques for DC motors; identify the mechanical parts, windings, and wiring connections for a single- and three-phase squirrel cage induction AC motor (SCIM); demonstrate manual and magnetic across-the-line starting techniques for single- and three-phase squirrel cage motors; demonstrate methods for forward and reverse control of single- and three-phase squirrel cage motors; demonstrate the control of a Single Phase Capacitor Start Dual Voltage Motor with a reversing drum switch, manual starter and a reversing magnetic starter; state the procedures for installing and aligning belt driven motors; and calculate and connect single-phase, 3-wire transformer services.

### ELE8725 INSTRUMENTATION - LEVEL 2

Upon successful completion, the apprentice is able to: identify and describe the operation of various level and flow sensing instruments; draw basic process and instrument diagrams using standard ISA instrumentation symbols; explain the operation and applications of typical level and flow measurement devices and transmitters; demonstrate the hydrostatic pressure principle of liquid level measurement; predict with calculations the effect of liquids of different specific gravities on the system; demonstrate the use of the venturi and the orifice plate in flow measurement; and install, connect and test load cells in typical weight measurement applications.

### ELE8726 ELECTRONICS - LEVEL 2

Upon successful completion, the apprentice will have demonstrated the ability to: use an oscilloscope to test circuits; explain the importance of isolation when using test equipment; describe and demonstrate half and full wave rectification; connect capacitors and inductors to filter a power supply output; demonstrate the use of a zener diode as a regulator; demonstrate the operation of an SCR; demonstrate the operation of a DIAC and TRIAC; demonstrate how a DIAC and RC network can be used to phase shift a TRIAC; describe the operation and applications of a pulse transformer; explain the operation of a field effect transistor (FET) and operational amp (Op Amp); calculate the expected gain of inverting and non-inverting OP-Amp circuits; and demonstrate the operation of an Op-Amp used as a comparator and an amplifier.

### ELE8727 MONITORING AND COMMUNICATION SYSTEMS - LEVEL 2

Upon successful completion, the apprentice will have demonstrated the ability to: describe the operation, installation, testing and troubleshooting requirements for initiation, signal, ancillary and supervisory circuits and devices, in a single two stage fire alarm system using the NBC, CEC, ULC and manufacturer's documentation; describe the basic operation of wet and dry sprinkler systems; describe the fire suppression agents, components and systems used in fire suppression systems; describe the methods used to terminate and test fibre optic cables; demonstrate an understanding intrusion systems and devices; describe the wiring and operation of nurse call systems; demonstrate the wiring and operation of nurse call systems; layout and wire common paging and communications systems; describe the operation of institutional clock systems; and describe the operation and installation requirements for common home automation systems.

### ELE8731 CANADIAN ELECTRICAL CODE - LEVEL 3

Upon successful completion, the apprentice is able to: interpret the CEC requirements pertaining to the installations for: two or more continuous and non-continuous duty service motor on a feeder or branch circuit; hermetic refrigerant motor-compressor; power and distribution transformers on a feeder and branch circuit; welders on a feeder and branch circuit; capacitors on a feeder, branch circuit and motor branch circuit; high-voltage installations; overcurrent device selection based on load, interrupting ratings and coordination.

### ELE8732 PRINTS - LEVEL 3

Upon successful completion, the apprentice is able to: obtain installation details for a construction project from a complete set of drawings and specifications; develop complex single line, schematic and wiring diagrams; layout single- and three-phase systems for feeder and branch circuits from utility supply to utilization points; calculate pulling stresses on a conductor/cable; layout the grounding and bonding requirements for high-voltage indoor and outdoor substations and vaults; identify precautions for installing stress cones; describe the requirements for terminating shielded and concentric neutral high-voltage cables; and describe the testing methods and safety requirements for testing high-voltage cables.

### ELE8733 ELECTRICAL THEORY - LEVEL 3

Upon successful completion, the apprentice is able to: list the advantages of three phase circuits over single phase circuits; state the advantages and disadvantages of three phase Wye and Delta systems; calculate voltage, current, power and power factor for three-phase Wye and Delta systems, three-phase series and parallel RLC circuits; connect wattmeters, power-factor meters and phase-angle meters in a three-phase system; list different types of transformers and their applications and associated losses; explain the principles of three-phase open delta connections; describe the theory of operation and the synchronizing of alternators; illustrate by calculation the principles for single and three-phase power conversion; describe the construction, operation and troubleshooting procedures for single- and three-phase AC induction motors; identify connections for multiple voltages and speeds for AC motors; describe the construction, operation and troubleshooting procedures for AC wound rotor motors; describe the construction, operation, power factor correction and troubleshooting procedures for three-phase synchronous motors; state the types of insulation.

### ELE8734 INSTALLATION METHODS - LEVEL 3

Upon successful completion, the apprentice is able to: test transformers to determine polarity, impedance, winding ratio and insulation resistance; connect three-phase transformers in Wye and Delta configurations; connect three-phase RLC loads to transformers in balanced and unbalanced configurations; connect single- and three-phase auto transformers for reduced voltage motor starting; identify the parts and connections for a three-phase wound rotor motor; describe the effects of differing resistance in the rotor circuit of a wound rotor motor under varying loads; connect a two-speed control circuit for a two-speed squirrel-cage motor; state the functions and applications of a Programmable Logic Controller (PLC); determine language and addressing requirements of a PLC; demonstrate the programming of common relay instructions, timers, counters, mathematic functions, and word comparisons on a PLC; identify methods and hard wiring of PLC's to equipment; demonstrate manner using many of the internal functions of a PLC.

### ELE8735 INSTRUMENTATION - LEVEL 3

Upon successful completion, the apprentice is able to: describe the use and list the requirements for instrumentation air supplies; explain terminology of instrumentation systems; describe the operation and applications of proportional 3-15 psi pneumatic instrumentation systems; connect and adjust pneumatic control valves to current/pressure (I/P) and pressure/current (P/I) devices; calibrate typical pneumatic valves; explain the principles of ON/OFF control; identify the four basic elements of a control system; explain the two general categories of automatic control and shielded cable in instrumentation systems; demonstrate shield grounding techniques; connect, program and test microprocessor based ultrasonic measuring transmitters; explain the operation and application of position measurement devices; install, connect and test resolver and shaft encoders; explain the principles of Proportional Integrated Derivative (PID) control; explain the advantages and limitations of the common methods of communicating instrumentation information; and revise and explain control loops on instrumentation drawings.

### ELE8737 ELECTRONICS - LEVEL 3

Upon successful completion, the apprentice is able to: state how three-phase rectification is accomplished; connect a single quadrant DC motor drive system; describe the relationship between firing angle, load, voltage, CEMF, and motor speed; describe application of two and four quadrant drive systems; describe and connect open and closed loop speed control systems; explain the operation of DC chopper drive controller; connect, calibrate and test an SCR speed controller for a DC system motor; describe the operation of a three-phase AC variable speed drive controller; connect, calibrate and confirm the operation of an AC variable speed drive controller; identify the major components of AC variable speed drive controller; explain the procedure to test, remove and replace the output transistors in an AC variable speed drive; describe the effects of harmonics on AC systems; explain the operation of reactors and their application to AC variable speed drive systems to control harmonics on AC Power Systems; describe the operation and application of encoders, resolvers, and tachogenerators as feedback devices; and explain the operation of and identify hardware and protocol for serial communication.