

## **COURSE ELT2010: ELECTRO-ASSEMBLY 2**

**Level:** Intermediate

**Prerequisite:** ELT1010: Electro-assembly 1

**Description:** Students apply electro-assembly technology to manufacture circuit boards.

**Parameters:** Access to a printed circuit fabrication kit and related resources.

**Outcomes:** The student will:

- 1. identify appropriate construction methods to fabricate a circuit board**
  - 1.1 research the benefits and drawbacks of prototype construction assembly methods
- 2. lay out and construct a simple electronic circuit board, using approved construction techniques**
  - 2.1 use schematic symbols to represent electronic components
  - 2.2 draw and/or modify schematic diagrams for a simple electronic circuit
  - 2.3 match actual components to schematic symbols
  - 2.4 use an etch-resistant pen or photographic method to make a circuit board project
- 3. use a printed circuit board and proper fabrication techniques to assemble a project**
  - 3.1 prototype an electronic circuit on a breadboard
  - 3.2 create the artwork circuit layout drawing for a printed circuit board
  - 3.3 practise printed circuit board building and component installation
  - 3.4 demonstrate appropriate safety techniques when using solder and chemicals for prototype construction
  - 3.5 evaluate the circuit using electronic instruments
  - 3.6 demonstrate how to troubleshoot an electronic circuit board
- 4. demonstrate established laboratory procedures and safe work practices**
  - 4.1 research illnesses caused by chemicals, solder and flux used in prototype construction
  - 4.2 identify and follow safe home/laboratory procedures while using solder, flux, photochemicals, cleaning chemicals and etching chemicals
- 5. demonstrate basic competencies**
  - 5.1 demonstrate fundamental skills to:
    - 5.1.1 communicate
    - 5.1.2 manage information
    - 5.1.3 use numbers
    - 5.1.4 think and solve problems
  - 5.2 demonstrate personal management skills to:
    - 5.2.1 demonstrate positive attitudes and behaviours
    - 5.2.2 be responsible
    - 5.2.3 be adaptable
    - 5.2.4 learn continuously
    - 5.2.5 work safely
  - 5.3 demonstrate teamwork skills to:
    - 5.3.1 work with others
    - 5.3.2 participate in projects and tasks
- 6. identify possible life roles related to the skills and content of this cluster**
  - 6.1 recognize and then analyze the opportunities and barriers in the immediate environment
  - 6.2 identify potential resources to minimize barriers and maximize opportunities



## **COURSE ELT2020: ELECTRICAL SERVICING**

**Level:** Intermediate

**Prerequisite:** ELT1010: Electro-assembly 1

**Description:** Students demonstrate the fundamental concepts of repairing, servicing and maintaining electrical and electronic equipment.

**Parameters:** Access to basic hand tools, testing equipment and related resources.

**Supporting Course:** ELT2010: Electro-assembly 2

**Outcomes:** The student will:

- 1. develop a basic repair and maintenance schedule for an electrical or electronic device**
  - 1.1 define current, resistance, magnetic field, voltage rating, temperature and wattage
  - 1.2 identify the types of data found on a name plate
  - 1.3 explain why the Canadian Standards Association (CSA) standards are applied to appliances
  - 1.4 create a service schedule including:
    - 1.4.1 nameplate data
    - 1.4.2 stages of operation
    - 1.4.3 charts and wiring schematics
    - 1.4.4 grounding techniques
    - 1.4.5 protection devices
    - 1.4.6 function of the unit
    - 1.4.7 frequency of use
    - 1.4.8 subjected conditions
    - 1.4.9 age
    - 1.4.10 cost of service
    - 1.4.11 cost of replacement service and cost to maintain and repair electrical or electronic devices by identifying potential problems and correcting
- 2. identify faults in an electrical or electronic device and propose solutions for repair**
  - 2.1 identify stages of operation of various types of electrical or electronic systems
  - 2.2 interpret a flow connection chart or wiring schematic of the system
  - 2.3 troubleshoot an electrical or electronic device
  - 2.4 explain and demonstrate how to repair electronic printed circuit boards
  - 2.5 measure the voltage, current and wattage of repaired items and compare the values with the nameplate ratings
- 3. use appropriate testing procedures to assess/repair an electrical or electronic device**
  - 3.1 describe standard procedures to locate circuit/component faults
  - 3.2 identify the problem and propose a solution to affect the repair
  - 3.3 use measurement techniques related to voltage, current, resistance, wattage and continuity to appraise the condition of the circuit
- 4. demonstrate established laboratory procedures and safe work practices**
  - 4.1 demonstrate a professional attitude of personal safety
  - 4.2 use proper grounding techniques, current protection and static protection when testing electronic circuits

**5. demonstrate basic competencies**

- 5.1 demonstrate fundamental skills to:
  - 5.1.1 communicate
  - 5.1.2 manage information
  - 5.1.3 use numbers
  - 5.1.4 think and solve problems
- 5.2 demonstrate personal management skills to:
  - 5.2.1 demonstrate positive attitudes and behaviours
  - 5.2.2 be responsible
  - 5.2.3 be adaptable
  - 5.2.4 learn continuously
  - 5.2.5 work safely
- 5.3 demonstrate teamwork skills to:
  - 5.3.1 work with others
  - 5.3.2 participate in projects and tasks

**6. identify possible life roles related to the skills and content of this cluster**

- 6.1 recognize and then analyze the opportunities and barriers in the immediate environment
- 6.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2030: BRANCH CIRCUIT WIRING**

**Level:** Intermediate

**Prerequisite:** ELT1030: Conversion & Distribution

**Description:** Students demonstrate the fundamentals of branch circuit wiring used in residential/commercial buildings.

**Parameters:** Access to basic hand tools, a multimeter and related resources.

**Note:** The student must have access to instruction from an individual with journeyman qualifications when projects are hardwired to main power supply and for permanent usage.

**Outcomes:** The student will:

- 1. identify and describe various branch wiring systems used in residential and commercial applications**
  - 1.1 draw schematic and pictorial diagrams of branch circuit wiring
  - 1.2 interpret architectural drawings regarding branch circuit wiring
  - 1.3 identify various wiring systems, methods and materials including:
    - 1.3.1 nonmetallic shielded cable (NMSC)
    - 1.3.2 armoured cable (BX)
    - 1.3.3 conduit and conductors
    - 1.3.4 teck cable
    - 1.3.5 raceway systems
    - 1.3.6 mineral insulated cable (Pyrotex)
    - 1.3.7 wire mould
- 2. apply Canadian Electrical Code (CEC) standards to various branch wiring system designs**
  - 2.1 compare series and parallel branch wiring circuits
  - 2.2 identify live, grounding and grounded branch circuit conductors
  - 2.3 measure voltage, current and continuity
  - 2.4 research requirements for obtaining an electrical permit
  - 2.5 identify CEC standards in branch circuit design and installation
- 3. wire a branch circuit for a residential application**
  - 3.1 demonstrate how to connect wiring to comply with CEC, local and Alberta standards
  - 3.2 demonstrate safe practices regarding grounding and overload protection of circuits and devices, such as case/receptacle grounding
  - 3.3 construct, according to CEC standards, the following branch circuits in NMSC:
    - 3.3.1 standard receptacle
    - 3.3.2 single location lamp switching
    - 3.3.3 switch receptacle
    - 3.3.4 range and/or dryer receptacle
    - 3.3.5 split receptacle
    - 3.3.6 multiple locations lamp switching
    - 3.3.7 ground fault interrupter (GFI) receptacle

- 3.4 construct, according to CEC standards, one of the above branch circuits using:
  - 3.4.1 armoured cable
  - 3.4.2 conduit raceway
- 3.5 install breakers and terminate branch circuit wiring in a single phase panelboard
- 4. demonstrate established laboratory procedures and safe work practices**
  - 4.1 describe the danger of electrical shocks and burns
  - 4.2 describe lockout/tagout practices
- 5. demonstrate basic competencies**
  - 5.1 demonstrate fundamental skills to:
    - 5.1.1 communicate
    - 5.1.2 manage information
    - 5.1.3 use numbers
    - 5.1.4 think and solve problems
  - 5.2 demonstrate personal management skills to:
    - 5.2.1 demonstrate positive attitudes and behaviours
    - 5.2.2 be responsible
    - 5.2.3 be adaptable
    - 5.2.4 learn continuously
    - 5.2.5 work safely
  - 5.3 demonstrate teamwork skills to:
    - 5.3.1 work with others
    - 5.3.2 participate in projects and tasks
- 6. identify possible life roles related to the skills and content of this cluster**
  - 6.1 recognize and then analyze the opportunities and barriers in the immediate environment
  - 6.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2050: ELECTRONIC POWER SUPPLY 2**

**Level:** Intermediate

**Prerequisite:** ELT1050: Electronic Power Supply 1

**Description:** Students construct and demonstrate the fundamentals of electronic power supply technology.

**Parameters:** Access to an oscilloscope, a multimeter, an isolation transformer and related resources.

**Supporting Course:** ELT2010: Electro-assembly 2

**Outcomes:** The student will:

- 1. construct, analyze and evaluate single-phase rectifiers**
  - 1.1 identify components responsible for improved output of a regulated filtered power supply
  - 1.2 explain the fundamentals of diodes, zeners, transistors and operational amplifiers
- 2. observe and test the voltage and waveform of a switching power supply**
  - 2.1 diagram half-wave bridge, full-wave bridge and centre-tap rectifiers
  - 2.2 identify current path in half-wave bridge, full-wave bridge and centre-tap rectifiers
- 3. build and analyze the characteristics of a power supply regulated by a zener transistor**
  - 3.1 construct, energize, measure and graph the input and output of half-wave bridge, full-wave bridge and centre-tap rectifiers, and regulated power supply
- 4. build, test and analyze filtering circuits used in electronic power supplies**
  - 4.1 mathematically analyze output voltage, ripple frequency and required peak inverse voltage of a half-wave bridge, full-wave bridge and centre-tap rectifier
  - 4.2 mathematically determine component values for the construction of a regulated power supply
  - 4.3 set-up, test and analyze a switching power supply
  - 4.4 construct a full-wave, filtered and regulated power supply
  - 4.5 test regulated power supply
- 5. demonstrate established laboratory procedures and safe work practices**
  - 5.1 use an isolation transformer
  - 5.2 demonstrate safe practices, especially regarding grounding and using an oscilloscope
- 6. demonstrate basic competencies**
  - 6.1 demonstrate fundamental skills to:
    - 6.1.1 communicate
    - 6.1.2 manage information
    - 6.1.3 use numbers
    - 6.1.4 think and solve problems
  - 6.2 demonstrate personal management skills to:
    - 6.2.1 demonstrate positive attitudes and behaviours
    - 6.2.2 be responsible
    - 6.2.3 be adaptable
    - 6.2.4 learn continuously
    - 6.2.5 work safely

- 6.3 demonstrate teamwork skills to:
  - 6.3.1 work with others
  - 6.3.2 participate in projects and tasks
- 7. identify possible life roles related to the skills and content of this cluster**
  - 7.1 recognize and then analyze the opportunities and barriers in the immediate environment
  - 7.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2080: CONTROL SYSTEMS 2**

**Level:** Intermediate

**Prerequisite:** ELT1080: Control Systems 1

**Description:** Students demonstrate how process control technology is used in real-world applications.

**Parameters:** Access to a power supply, an oscilloscope, a transistor checker, breadboards, a frequency counter, a digital multimeter and related resources.

**Outcomes:** The student will:

### **1. identify discrete components used in process control**

- 1.1 relate schematic diagrams and connection symbols to real-world devices
- 1.2 explain differences between alternating current (AC) and direct current (DC) as they relate to semiconductor components
- 1.3 explain the differences among the following circuit conditions:
  - 1.3.1 grounded system
  - 1.3.2 floating system
  - 1.3.3 isolated system
- 1.4 explain the voltage, current and resistance differences among series, parallel and series parallel circuits, using Ohm's law

### **2. identify and describe analog and sensor components used in process control**

- 2.1 describe an analog signal through both open- and closed-loop control systems
- 2.2 research applications of solid-state control circuits in automotive, home and industrial application systems

### **3. construct a process control device, using analog and sensor components**

- 3.1 explain, experiment with and demonstrate knowledge of various semiconductor components by prototyping mini control circuits in various applications including:
  - 3.1.1 rectifiers
  - 3.1.2 silicon controlled rectifier transistors
  - 3.1.3 unijunction transistors
  - 3.1.4 triac
  - 3.1.5 diac
  - 3.1.6 field-effect transistors
  - 3.1.7 junction field-effect transistors
  - 3.1.8 metal-oxide-semiconductor field-effect transistors
  - 3.1.9 timers; e.g., 555s
  - 3.1.10 operational amplifiers
  - 3.1.11 solid-state relays
- 3.2 explain, experiment with and demonstrate various semiconductor transducers and sensors including:
  - 3.2.1 thermistor
  - 3.2.2 pressure sensor
  - 3.2.3 photoelectric transducers
  - 3.2.4 hall effect
  - 3.2.5 optocouplers

- 3.2.6 bar codes
- 3.2.7 light controller resistors
- 3.2.8 light-emitting diode
- 3.2.9 photodiode
- 3.2.10 phototransistor
- 3.2.11 proximity switches
- 3.3 construct an electronic project(s) to control home environment or vehicle function by:
  - 3.3.1 troubleshooting the project
  - 3.3.2 writing a technical report describing the control system operation
  - 3.3.3 developing a flow chart and block diagram to show process control in project(s)
- 3.4 demonstrate correct use and procedure in operating an oscilloscope
- 3.5 demonstrate knowledge of testing semiconductor components including transducers and sensors, multimeters, oscilloscopes, solid-state testers
- 4. demonstrate established laboratory procedures and safe work practices**
  - 4.1 describe hazards associated with voltage, including capacitor discharge, currents, grounded systems, floating systems and isolated systems
- 5. demonstrate basic competencies**
  - 5.1 demonstrate fundamental skills to:
    - 5.1.1 communicate
    - 5.1.2 manage information
    - 5.1.3 use numbers
    - 5.1.4 think and solve problems
  - 5.2 demonstrate personal management skills to:
    - 5.2.1 demonstrate positive attitudes and behaviours
    - 5.2.2 be responsible
    - 5.2.3 be adaptable
    - 5.2.4 learn continuously
    - 5.2.5 work safely
  - 5.3 demonstrate teamwork skills to:
    - 5.3.1 work with others
    - 5.3.2 participate in projects and tasks
- 6. identify possible life roles related to the skills and content of this cluster**
  - 6.1 recognize and then analyze the opportunities and barriers in the immediate environment
  - 6.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2090: ANALOG COMMUNICATION 2**

**Level:** Intermediate

**Prerequisite:** ELT1090: Analog Communication 1

**Description:** Students demonstrate the fundamental concepts of electronic analog communication systems.

**Parameters:** Access to an oscilloscope, a signal generator, a transistor checker, a multimeter, a decibel (dB) meter and related resources.

**Outcomes:** The student will:

### **1. identify characteristics of analog communication systems**

- 1.1 research the history of the beginnings of electrical communication
- 1.2 describe what is meant by an analog signal
- 1.3 identify various devices used to convert sound into electrical signals
- 1.4 explain how an electrical signal is turned into sound
- 1.5 mathematically determine component values for crossover/band pass filters
- 1.6 describe how an FM or AM radio station, a television station or a theatre uses communication equipment

### **2. explain analog communication technology through project design, construction, experimentation, circuit analysis and electronic component identification**

- 2.1 draw and explain the block diagram of a simple communication model
- 2.2 identify the differences between wire and wireless telephone systems' technology and networking
- 2.3 using a block diagram, explain the operation of the following forms of analog electronic communication systems:
  - 2.3.1 telephones
  - 2.3.2 audio amplifiers
  - 2.3.3 intercom systems
  - 2.3.4 light and sound boards
  - 2.3.5 automotive sensors (analog)
- 2.4 build a small audio amplifier and/or intercom for personal use
- 2.5 construct a speaker system with low-, mid- and high-range speakers with appropriate crossover networks such as an intercom system
- 2.6 test the project using analog test instruments such as an analog multimeter and an oscilloscope

### **3. demonstrate established laboratory procedures and safe work practices**

- 3.1 identify and describe the difference between a dB meter and dB ratings of communications systems and the effects on human hearing
- 3.2 troubleshoot, repair and maintain analog communication systems used in the home including:
  - 3.2.1 portable stereo systems

### **4. demonstrate basic competencies**

- 4.1 demonstrate fundamental skills to:
  - 4.1.1 communicate
  - 4.1.2 manage information
  - 4.1.3 use numbers
  - 4.1.4 think and solve problems

- 4.2 demonstrate personal management skills to:
  - 4.2.1 demonstrate positive attitudes and behaviours
  - 4.2.2 be responsible
  - 4.2.3 be adaptable
  - 4.2.4 learn continuously
  - 4.2.5 work safely
- 4.3 demonstrate teamwork skills to:
  - 4.3.1 work with others
  - 4.3.2 participate in projects and tasks
- 5. identify possible life roles related to the skills and content of this cluster**
  - 5.1 recognize and then analyze the opportunities and barriers in the immediate environment
  - 5.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2110: SECURITY SYSTEMS 2**

**Level:** Intermediate

**Prerequisite:** ELT1110: Security Systems 1

**Description:** Students demonstrate the fundamentals of security technology used in homes, businesses and transportation systems.

**Parameters:** Access to a digital multimeter, a soldering station, a breadboard, a power supply, hand tools and related resources.

**Supporting Course:** ELT2080: Control Systems 2

**Outcomes:** The student will:

### **1. identify and describe elements of a security system**

- 1.1 explain terms including:
  - 1.1.1 transceivers
  - 1.1.2 frequency
  - 1.1.3 microwave
  - 1.1.4 infrared radiation
  - 1.1.5 relays
  - 1.1.6 open and closed contact switches
- 1.2 research long-range security monitoring

### **2. identify detection and notification devices**

- 2.1 identify and describe the following detection devices:
  - 2.1.1 proximity switches
  - 2.1.2 contact switches
  - 2.1.3 vibration detector
  - 2.1.4 glass breakage detector (foil strip)
  - 2.1.5 photoelectric beam
  - 2.1.6 ultrasonic motion detector
  - 2.1.7 microwave motion detector
  - 2.1.8 passive infrared motion detector
  - 2.1.9 dual technology detectors
  - 2.1.10 audio switch or sound discriminators
- 2.2 explain, experiment with or connect various notification devices

### **3. fabricate and operate a detection and notification alarm system for home or car use**

- 3.1 identify the following three basic elements of a security system:
  - 3.1.1 control panel
  - 3.1.2 detection devices
  - 3.1.3 means of notification (alarm)
- 3.2 research the differences between two different security systems
- 3.3 install, test and demonstrate an advanced security system incorporating a control panel, detectors and notification devices
- 3.4 explain the operation of various notification alarms by:
  - 3.4.1 identifying who is notified by each type of alarm
- 3.5 design or construct an electronic security system for personal use

- 3.6 create a flowchart and block diagram to show detection, monitoring and alarm signals
- 3.7 write a technical report describing the security system
- 4. demonstrate established laboratory procedures and safe work practices**
  - 4.1 describe voltage and current hazards of security systems
  - 4.2 demonstrate correct handling of batteries used in security systems
  - 4.3 demonstrate how to recharge a battery safely
- 5. demonstrate basic competencies**
  - 5.1 demonstrate fundamental skills to:
    - 5.1.1 communicate
    - 5.1.2 manage information
    - 5.1.3 use numbers
    - 5.1.4 think and solve problems
  - 5.2 demonstrate personal management skills to:
    - 5.2.1 demonstrate positive attitudes and behaviours
    - 5.2.2 be responsible
    - 5.2.3 be adaptable
    - 5.2.4 learn continuously
    - 5.2.5 work safely
  - 5.3 demonstrate teamwork skills to:
    - 5.3.1 work with others
    - 5.3.2 participate in projects and tasks
- 6. identify possible life roles related to the skills and content of this cluster**
  - 6.1 recognize and then analyze the opportunities and barriers in the immediate environment
  - 6.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2120: ELECTRO-OPTICS**

**Level:** Intermediate

**Prerequisite:** None

**Description:** Students demonstrate basic knowledge of lasers and other light wave communication applications in various electronic systems.

**Parameters:** Access to a laser experimental kit and related resources.

**Outcomes:** The student will:

### **1. identify common types and classes of lasers**

- 1.1 define the word laser
- 1.2 research Canadian Standards Association (CSA) standards/guidelines for lasers
- 1.3 define lasers in terms of power
- 1.4 draw a block diagram of a laser
- 1.5 explain four unique properties of laser light
- 1.6 describe how light can be used as a modulation medium
- 1.7 research laser technology applications

### **2. explain the operation of laser, fibre optic, infrared and hologram light wave technology**

- 2.1 define fibre optics, infrared and hologram
- 2.2 explain the following terms as related to fibre optics:
  - 2.2.1 reflection
  - 2.2.2 refraction
  - 2.2.3 lenses
  - 2.2.4 focal length
  - 2.2.5 absorption
  - 2.2.6 angle of incidence
  - 2.2.7 bar code
  - 2.2.8 cladding
  - 2.2.9 core
  - 2.2.10 attenuation
- 2.3 explain the operation of infrared communication systems
- 2.4 explain the process of producing a hologram
- 2.5 explain the six major types of lenses
- 2.6 explain the effect prisms have on light
- 2.7 explain beam splitters
- 2.8 describe the effects the following filters have on light:
  - 2.8.1 coloured gel
  - 2.8.2 interference
  - 2.8.3 dichroic
- 2.9 explain diffraction gratings
- 2.10 explain terms used in laser technology including:
  - 2.10.1 photon
  - 2.10.2 ground state
  - 2.10.3 excited state
  - 2.10.4 spontaneous emission

- 2.10.5 stimulated emission of radiation
- 2.10.6 pumping
- 2.10.7 population inversion
- 2.10.8 light amplification
- 2.10.9 lenses
- 2.10.10 multiwatt lasers
- 2.11 identify and explain the operation of the following laser components:
  - 2.11.1 power supply
  - 2.11.2 pumping device
  - 2.11.3 lasing medium
  - 2.11.4 optical resonant cavity
- 2.12 define the following types of lasers:
  - 2.12.1 crystal and glass
  - 2.12.2 excimer
  - 2.12.3 chemical
  - 2.12.4 semiconductor
  - 2.12.5 gas lasers including:
    - 2.12.5.1 helium–neon (HeNe)
    - 2.12.5.2 argon
    - 2.12.5.3 carbon dioxide
    - 2.12.5.4 krypton
- 2.13 draw a diagram of a HeNe-neon laser
- 3. construct an electro-optical project**
  - 3.1 prototype, experiment with and analyze the following light wave communication devices:
    - 3.1.1 a visible light-emitting diode transmitter
    - 3.1.2 an alarm circuit using a phototransistor or optocoupler
    - 3.1.3 a simple infrared remote control device
    - 3.1.4 using a fibre optic cable to route light to a remote location
    - 3.1.5 transmitting analog data through a fibre using a diode laser
    - 3.1.6 constructing a simple alarm using high intensity visible light-emitting diode
  - 3.2 prototype, analyze and construct an advanced laser, fibre optical, infrared or hologram project including:
    - 3.2.1 a HeNe laser experimenters system
    - 3.2.2 a pocket laser diode
    - 3.2.3 an infrared push-button remote control
    - 3.2.4 an infrared wireless speaker system
    - 3.2.5 retro-fitted old equipment using a remote control
    - 3.2.6 a laser light show
    - 3.2.7 a fibre optical communication system
    - 3.2.8 a fibre optic vibration detection
    - 3.2.9 a system for the home
    - 3.2.10 a split-beam transmission hologram
- 4. demonstrate established laboratory procedures and safe work practices**
  - 4.1 follow safe practices when:
    - 4.1.1 using potentially hazardous materials in project construction
    - 4.1.2 laser light radiation is present
    - 4.1.3 exposed to high voltages around lasers
    - 4.1.4 using laser classes I, II, III, IV
    - 4.1.5 working with high voltage capacitors

**5. demonstrate basic competencies**

5.1 demonstrate fundamental skills to:

- 5.1.1 communicate
- 5.1.2 manage information
- 5.1.3 use numbers
- 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:

- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:

- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

**6. identify possible life roles related to the skills and content of this cluster**

6.1 recognize and then analyze the opportunities and barriers in the immediate environment

6.2 identify potential resources to minimize barriers and maximize opportunities



## **COURSE ELT2130: MAGNETIC CONTROL DEVICES**

**Level:** Intermediate

**Prerequisite:** ELT1010: Electro-assembly 1

**Description:** Students demonstrate the fundamentals of electromagnetic control devices.

**Parameters:** Access to a multimeter, a clamp-on ammeter, a power supply, hand tools and related resources.

**Outcomes:** The student will:

- 1. identify and state the function of electromagnetic control devices**
  - 1.1 research the benefits and drawbacks of electromagnetic and solid-state relays
  - 1.2 identify coil voltage and frequency ratings
  - 1.3 identify contact voltage and current ratings
  - 1.4 compare and contrast the use of relays, solenoids and actuators in electrical circuits
  - 1.5 demonstrate knowledge of electromagnetism
- 2. explain the operation of electromagnetically controlled systems**
  - 2.1 demonstrate knowledge of activation principles
- 3. design and construct electromagnetic circuits, using ladder logic systems and wiring diagrams**
  - 3.1 draw a schematic and wiring diagram and construct the following electromagnetic circuits:
    - 3.1.1 toggle switch controls load
    - 3.1.2 stop/start button controls load
    - 3.1.3 toggle switch controls
    - 3.1.4 limit switches
    - 3.1.5 stop/start from two locations
    - 3.1.6 jogging
    - 3.1.7 reversing
    - 3.1.8 annunciator and indicators
  - 3.2 create a flowchart of various magnetic control systems
- 4. demonstrate basic competencies**
  - 4.1 demonstrate fundamental skills to:
    - 4.1.1 communicate
    - 4.1.2 manage information
    - 4.1.3 use numbers
    - 4.1.4 think and solve problems
  - 4.2 demonstrate personal management skills to:
    - 4.2.1 demonstrate positive attitudes and behaviours
    - 4.2.2 be responsible
    - 4.2.3 be adaptable
    - 4.2.4 learn continuously
    - 4.2.5 work safely
  - 4.3 demonstrate teamwork skills to:
    - 4.3.1 work with others
    - 4.3.2 participate in projects and tasks
- 5. identify possible life roles related to the skills and content of this cluster**
  - 5.1 recognize and then analyze the opportunities and barriers in the immediate environment
  - 5.2 identify potential resources to minimize barriers and maximize opportunities



## **COURSE ELT2140: ROBOTICS 2**

**Level:** Intermediate

**Prerequisite:** ELT1130: Robotics 1  
OR  
ELT1140: Robotics Applications

**Description:** Students demonstrate the fundamental concepts of sensor devices and control systems by building an electronic circuit to control a direct wire or mobile robot.

**Parameters:** Access to a multimeter, a power supply, soldering stations, hand tools and related resources.

**Outcomes:** The student will:

- 1. design and build a sensor device and control system for the robotic system**
  - 1.1 demonstrate the principles of photoelectric, sound, tactile, proximity and thermal sensors
  - 1.2 explain the operation of the electronic components and circuits used to build sensor controls
  - 1.3 explain how sensor control systems are used to control the drive circuit
  - 1.4 assemble electronic components to build a sensor
- 2. identify sensor control systems and subsystems used in robotic systems**
  - 2.1 draw and explain the various blocks in a sensor control system
  - 2.2 describe and explain sight, sound and tactile sensor devices
  - 2.3 explain the fundamentals of the control system operating the motor drives in the robotic system
  - 2.4 identify the differences among drive systems, sensor control systems and processing systems
- 3. explain sensory control circuits and components used in the robotic control system**
  - 3.1 research the benefits and drawbacks of various sensory devices that are used to control the robot
  - 3.2 describe where industry is making use of sensory control robots
- 4. operate and demonstrate the capabilities of a robotic system equipped with sensor controls**
  - 4.1 demonstrate a knowledge of sensory control systems by building a sensor control for the robot system selecting from the following:
    - 4.1.1 photoelectric
    - 4.1.2 sound
    - 4.1.3 tactile
    - 4.1.4 proximity
    - 4.1.5 thermal
  - 4.2 prototype a sensory control system and construct the circuit so that the sensor controls the motors on the robot
  - 4.3 build a sensory control and mount the sensory control on the control robot
  - 4.4 draw the schematic diagram of the sensor control circuit
- 5. demonstrate established laboratory procedures and safe work practices**
  - 5.1 demonstrate safe wiring practices when building a sensory control system
  - 5.2 use protection devices for all circuits including fusing and temperature cutoff
  - 5.3 operate robotic systems within design tolerances

**6. demonstrate basic competencies**

- 6.1 demonstrate fundamental skills to:
  - 6.1.1 communicate
  - 6.1.2 manage information
  - 6.1.3 use numbers
  - 6.1.4 think and solve problems
- 6.2 demonstrate personal management skills to:
  - 6.2.1 demonstrate positive attitudes and behaviours
  - 6.2.2 be responsible
  - 6.2.3 be adaptable
  - 6.2.4 learn continuously
  - 6.2.5 work safely
- 6.3 demonstrate teamwork skills to:
  - 6.3.1 work with others
  - 6.3.2 participate in projects and tasks

**7. identify possible life roles related to the skills and content of this cluster**

- 7.1 recognize and then analyze the opportunities and barriers in the immediate environment
- 7.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2150: ELECTRONIC CONTROLS**

**Level:** Intermediate

**Prerequisite:** ELT2130: Magnetic Control Devices

**Description:** Students demonstrate the fundamentals of ladder/relay logic programming and how the programmable logic controller (PLC) system operates.

**Parameters:** Access to a programmable logic controller, a soldering station, hand tools and related resources.

**Note:** The student must have access to instruction from an individual with journeyman qualifications when projects are hardwired to main power supply and intended for permanent usage.

**Outcomes:** The student will:

- 1. explain basic input and output hardware and fundamentals of basic programming in PLC systems**
  - 1.1 research the benefits and drawbacks of using PLC systems
  - 1.2 research where, how and why PLCs are used in industry
- 2. write a basic programming logic code, through real or programmed inputs on a PLC system to operate and control electromagnetic devices**
  - 2.1 draw and identify the various blocks of a PLC system
  - 2.2 draw PLC ladder programs complete with wiring diagrams of inputs and outputs systems
  - 2.3 describe and explain numbering systems and codes
  - 2.4 plan PLC ladder programs and wiring diagrams of the PLC system
  - 2.5 demonstrate the fundamentals of logic
  - 2.6 compare relay logic control and PLC programming
  - 2.7 convert relay ladder diagrams into PLC ladder programs
  - 2.8 identify the differences between a wired relay motor control panel and a PLC motor control panel
- 3. wire, operate and test a programmable electromagnetic device**
  - 3.1 build and program a multi-input/output PLC control installation
  - 3.2 demonstrate principles of electromagnetic relay output devices to control motors
  - 3.3 demonstrate the action of switch devices as an input sensor device
  - 3.4 design the relay logic program and construct the input and output devices so that the PLC can control electromagnetic and indicator lamps
  - 3.5 demonstrate a knowledge of PLC function by writing basic programs to operate a simple relay logic control of AC motors
  - 3.6 explain how an AC motor is operated by a PLC
- 4. demonstrate established laboratory procedures and safe work practices**
  - 4.1 demonstrate safe wiring practices when wiring the input and output circuits
  - 4.2 use protection devices for all circuits

**5. demonstrate basic competencies**

- 5.1 demonstrate fundamental skills to:
  - 5.1.1 communicate
  - 5.1.2 manage information
  - 5.1.3 use numbers
  - 5.1.4 think and solve problems
- 5.2 demonstrate personal management skills to:
  - 5.2.1 demonstrate positive attitudes and behaviours
  - 5.2.2 be responsible
  - 5.2.3 be adaptable
  - 5.2.4 learn continuously
  - 5.2.5 work safely
- 5.3 demonstrate teamwork skills to:
  - 5.3.1 work with others
  - 5.3.2 participate in projects and tasks

**6. identify possible life roles related to the skills and content of this cluster**

- 6.1 recognize and then analyze the opportunities and barriers in the immediate environment
- 6.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2160: ROBOTICS SENSOR 1**

**Level:** Intermediate

**Prerequisite:** ELT1140: Robotics Applications

**Description:** Students demonstrate how basic sensors are used in a robotic system.

**Parameters:** Access to a programmable robotic system with basic sensors and a digital multimeter.

**Outcomes:** The student will:

- 1. describe the difference between active and passive sensors**
  - 1.1 describe active and passive sensors and compare when each would be used
- 2. identify and describe basic sensors used in programmable robotics systems**
  - 2.1 describe how a basic sensor signal is produced and “read” by the programmable robotics system
  - 2.2 identify and describe the uses of the following sensors:
    - 2.2.1 touch
    - 2.2.2 imaging
    - 2.2.3 light
    - 2.2.4 speech
    - 2.2.5 sound
    - 2.2.6 smell
    - 2.2.7 temperature
    - 2.2.8 ultrasonic
    - 2.2.9 rotation
- 3. verify sensory input conversion, interpretation and reaction in programmable robotics systems**
  - 3.1 identify programmable robotics system sensor signal input requirements
- 4. devise a programmable robotics system using at least three sensors to complete a task**
  - 4.1 develop a design solution including sensor specifications for robotics function to meet design drive criteria
  - 4.2 solve a design problem incorporating at least three sensors with a minimum of one active and one passive sensor
  - 4.3 construct a programmable robotics system to meet design criteria
  - 4.4 program a programmable robotics system to accomplish design criteria
- 5. demonstrate established laboratory procedures and safe work practices**
  - 5.1 explain motor loading and safe sensor operating ranges
  - 5.2 identify and follow laboratory safety procedures
- 6. demonstrate basic competencies**
  - 6.1 demonstrate fundamental skills to:
    - 6.1.1 communicate
    - 6.1.2 manage information
    - 6.1.3 use numbers
    - 6.1.4 think and solve problems
  - 6.2 demonstrate personal management skills to:
    - 6.2.1 demonstrate positive attitudes and behaviours
    - 6.2.2 be responsible
    - 6.2.3 be adaptable
    - 6.2.4 learn continuously
    - 6.2.5 work safely

- 6.3 demonstrate teamwork skills to:
  - 6.3.1 work with others
  - 6.3.2 participate in projects and tasks
- 7. identify possible life roles related to the skills and content of this cluster**
  - 7.1 recognize and then analyze the opportunities and barriers in the immediate environment
  - 7.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2170: ROBOTICS SENSOR 2**

**Level:** Intermediate

**Prerequisite:** ELT2160: Robotics Sensor 1

**Description:** Students demonstrate how specialized sensors are used in a robotic system.

**Parameters:** Access to programmable robotic system with specialized sensors.

**Outcomes:** The student will:

### **1. identify and describe specialized sensors used in programmable robotic system**

- 1.1 describe what a digital input is
- 1.2 describe what an analog input is
- 1.3 identify and describe the following sensors and their uses:
  - 1.3.1 colour
  - 1.3.2 speed
  - 1.3.3 balance (gyro)
  - 1.3.4 hall effect
  - 1.3.5 pressure
  - 1.3.6 angle sensor
  - 1.3.7 current
  - 1.3.8 compass
  - 1.3.9 voltage
  - 1.3.10 humidity
  - 1.3.11 position
  - 1.3.12 air pressure
  - 1.3.13 pH sensor
  - 1.3.14 accelerometer
  - 1.3.15 infrared
  - 1.3.16 global positioning system

### **2. describe sensory input conversion, interpretation and reaction in robotics systems**

- 2.1 using design requirements select sensor type and source technical data and manufacturer

### **3. identify and specify interface between processor and sensor**

- 3.1 identify processor and sensor compatibility with respect to voltage and current requirements
- 3.2 specify interface components required for processor and sensor compatibility

### **4. develop a robotic system using at least three specialized sensors to complete a specific task**

- 4.1 develop a design solution including specialized sensor specifications for programmable robotic functions to meet design criteria
- 4.2 solve a design problem incorporating three specialized sensors
- 4.3 construct a programmable robotics system to meet design criteria
- 4.4 program a programmable robotic system to accomplish design criteria
- 4.5 test the robotic system to verify that fabrication and programming meet design criteria

### **5. demonstrate established laboratory procedures and safe work practices**

- 5.1 identify and follow laboratory safety procedures
- 5.2 identify processor protection devices
- 5.3 identify ancillary circuit protection devices

**6. demonstrate basic competencies**

- 6.1 demonstrate fundamental skills to:
  - 6.1.1 communicate
  - 6.1.2 manage information
  - 6.1.3 use numbers
  - 6.1.4 think and solve problems
- 6.2 demonstrate personal management skills to:
  - 6.2.1 demonstrate positive attitudes and behaviours
  - 6.2.2 be responsible
  - 6.2.3 be adaptable
  - 6.2.4 learn continuously
  - 6.2.5 work safely
- 6.3 demonstrate teamwork skills to:
  - 6.3.1 work with others
  - 6.3.2 participate in projects and tasks

**7. identify possible life roles related to the skills and content of this cluster**

- 7.1 recognize and then analyze the opportunities and barriers in the immediate environment
- 7.2 identify potential resources to minimize barriers and maximize opportunities



- 5.2.4 learn continuously
- 5.2.5 work safely
- 5.3 demonstrate teamwork skills to:
  - 5.3.1 work with others
  - 5.3.2 participate in projects and tasks
- 6. identify possible life roles related to the skills and content of this cluster**
  - 6.1 recognize and then analyze the opportunities and barriers in the immediate environment
  - 6.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2910: ELT PROJECT B**

**Level:** Intermediate

**Prerequisite:** None

**Description:** Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

**Parameters:** Intermediate project courses must connect with a minimum of two CTS courses, one of which must be at the intermediate level and be in the same occupational area as the project course. The other CTS course(s) can be at any level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

**All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.**

### **Outcomes:**

The teacher/student will:

- 1. identify the connection between this project course and two or more CTS courses**
  - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
  - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
- 2. propose the project and/or performance**
  - 2.1 identify the project and/or performance by:
    - 2.1.1 preparing a plan
    - 2.1.2 clarifying the purposes
    - 2.1.3 defining the deliverables
    - 2.1.4 specifying time lines
    - 2.1.5 explaining terminology, tools and processes
    - 2.1.6 defining resources; e.g., materials, costs, staffing
  - 2.2 identify and comply with all related health and safety standards
  - 2.3 define assessment standards (indicators for success)
  - 2.4 present the proposal and obtain necessary approvals

The student will:

- 3. meet goals as defined within the plan**
  - 3.1 complete the project and/or performance as outlined
  - 3.2 monitor the project and/or performance and make necessary adjustments
  - 3.3 present the project and/or performance, indicating the:
    - 3.3.1 outcomes attained
    - 3.3.2 relationship of outcomes to goals originally set

- 3.4 evaluate the project and/or performance, indicating the:
  - 3.4.1 processes and strategies used
  - 3.4.2 recommendations on how the project and/or performance could have been improved
- 4. demonstrate basic competencies**
  - 4.1 demonstrate fundamental skills to:
    - 4.1.1 communicate
    - 4.1.2 manage information
    - 4.1.3 use numbers
    - 4.1.4 think and solve problems
  - 4.2 demonstrate personal management skills to:
    - 4.2.1 demonstrate positive attitudes and behaviours
    - 4.2.2 be responsible
    - 4.2.3 be adaptable
    - 4.2.4 learn continuously
    - 4.2.5 work safely
  - 4.3 demonstrate teamwork skills to:
    - 4.3.1 work with others
    - 4.3.2 participate in projects and tasks
- 5. identify possible life roles related to the skills and content of this cluster**
  - 5.1 recognize and then analyze the opportunities and barriers in the immediate environment
  - 5.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2920: ELT PROJECT C**

**Level:** Intermediate

**Prerequisite:** None

**Description:** Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

**Parameters:** Intermediate project courses must connect with a minimum of two CTS courses, one of which must be at the intermediate level and be in the same occupational area as the project course. The other CTS course(s) can be at any level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

**All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.**

### **Outcomes:**

The teacher/student will:

- 1. identify the connection between this project course and two or more CTS courses**
  - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
  - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
- 2. propose the project and/or performance**
  - 2.1 identify the project and/or performance by:
    - 2.1.1 preparing a plan
    - 2.1.2 clarifying the purposes
    - 2.1.3 defining the deliverables
    - 2.1.4 specifying time lines
    - 2.1.5 explaining terminology, tools and processes
    - 2.1.6 defining resources; e.g., materials, costs, staffing
  - 2.2 identify and comply with all related health and safety standards
  - 2.3 define assessment standards (indicators for success)
  - 2.4 present the proposal and obtain necessary approvals

The student will:

- 3. meet goals as defined within the plan**
  - 3.1 complete the project and/or performance as outlined
  - 3.2 monitor the project and/or performance and make necessary adjustments
  - 3.3 present the project and/or performance, indicating the:
    - 3.3.1 outcomes attained
    - 3.3.2 relationship of outcomes to goals originally set

- 3.4 evaluate the project and/or performance, indicating the:
  - 3.4.1 processes and strategies used
  - 3.4.2 recommendations on how the project and/or performance could have been improved
- 4. demonstrate basic competencies**
  - 4.1 demonstrate fundamental skills to:
    - 4.1.1 communicate
    - 4.1.2 manage information
    - 4.1.3 use numbers
    - 4.1.4 think and solve problems
  - 4.2 demonstrate personal management skills to:
    - 4.2.1 demonstrate positive attitudes and behaviours
    - 4.2.2 be responsible
    - 4.2.3 be adaptable
    - 4.2.4 learn continuously
    - 4.2.5 work safely
  - 4.3 demonstrate teamwork skills to:
    - 4.3.1 work with others
    - 4.3.2 participate in projects and tasks
- 5. identify possible life roles related to the skills and content of this cluster**
  - 5.1 recognize and then analyze the opportunities and barriers in the immediate environment
  - 5.2 identify potential resources to minimize barriers and maximize opportunities

## **COURSE ELT2950: ELT INTERMEDIATE PRACTICUM**

**Level:** Intermediate

**Prerequisite:** None

**Description:** Students apply prior learning and demonstrate the attitudes, skills and knowledge required by an external organization to achieve a credential/credentials or an articulation.

**Parameters:** This practicum course, which may be delivered on- or off-campus, should be accessed only by students continuing to work toward attaining a recognized credential/credentials or an articulation offered by an external organization. This course must be connected to at least one CTS course from the same occupational area and cannot be used in conjunction with any advanced (3XXX) level course. A practicum course cannot be delivered as a stand-alone course, cannot be combined with a CTS project course and cannot be used in conjunction with the Registered Apprenticeship Program or the Green Certificate Program.

**Outcomes:** The student will:

**1. perform assigned tasks and responsibilities, as required by the organization granting the credential(s) or articulation**

- 1.1 identify regulations and regulatory bodies related to the credential(s) or articulation
- 1.2 describe personal roles and responsibilities, including:
  - 1.2.1 key responsibilities
  - 1.2.2 support functions/responsibilities/expectations
  - 1.2.3 code of ethics and/or conduct
- 1.3 describe personal work responsibilities and categorize them as:
  - 1.3.1 routine tasks; e.g., daily, weekly, monthly, yearly
  - 1.3.2 non-routine tasks; e.g., emergencies
  - 1.3.3 tasks requiring personal judgement
  - 1.3.4 tasks requiring approval of a supervisor
- 1.4 demonstrate basic employability skills and perform assigned tasks and responsibilities related to the credential(s) or articulation

**2. analyze personal performance in relation to established standards**

- 2.1 evaluate application of the attitudes, skills and knowledge developed in related CTS courses
- 2.2 evaluate standards of performance in terms of:
  - 2.2.1 quality of work
  - 2.2.2 quantity of work
- 2.3 evaluate adherence to workplace legislation related to health and safety
- 2.4 evaluate the performance requirements of an individual who is trained, experienced and employed in a related occupation in terms of:
  - 2.4.1 training and certification
  - 2.4.2 interpersonal skills
  - 2.4.3 technical skills
  - 2.4.4 ethics

**3. demonstrate basic competencies**

3.1 demonstrate fundamental skills to:

- 3.1.1 communicate
- 3.1.2 manage information
- 3.1.3 use numbers
- 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:

- 3.2.1 demonstrate positive attitudes and behaviours
- 3.2.2 be responsible
- 3.2.3 be adaptable
- 3.2.4 learn continuously
- 3.2.5 work safely

3.3 demonstrate teamwork skills to:

- 3.3.1 work with others
- 3.3.2 participate in projects and tasks

**4. identify possible life roles related to the skills and content of this cluster**

- 4.1 recognize and then analyze the opportunities and barriers in the immediate environment
- 4.2 identify potential resources to minimize barriers and maximize opportunities