Construction Electrician/Industrial Electrician/Power Electrician
Common Core – Level 2

04-2025

Apprenticeship Manitoba

Construction Electrician/Industrial Electrician/Power Electrician

Unit: B1 Commercial Electrical Code

Level: Two

Duration: 60 hours

Theory: 60 hours

Practical: 0 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about the commercial electrical code. The unit begins with coverage of commercial wiring methods, wiring devices and system voltages and circuitry. Part of the unit covers raceway fill and branch circuit calculations. Finally, the unit covers single conductor cable and single and three phase motor installations.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Describe commercial system voltages and circuitry.	**10%**
a. Single-phase 3-wire system	
b. Three-phase 4-wire system	
c. Potential circuit problems	
d. Branch circuits, feeders and service conductors	
2. Describe commercial wiring installation and maintenance.	**20%**
a. CEC requirements	
b. Conductors, cables, raceways and flexible cords	
• Ampacities	
• Derations	
• Conditions of use	
• Metallurgy (compatibility of materials)	
c. Bonding and grounding	
d. Ground fault systems	
e. Grounding for lightning protection systems	
f. Perform related calculations.	
• Voltage drop calculations	
• Conductor derating calculations	
3. Describe commercial wiring devices and applications.	**15%**
a. CEC requirements	
b. Outlet and junction boxes	
• Sizes	
• Types	
• Applications	

- Box fill calculations
- Pull box calculations

c. Receptacles
d. Switches
e. Luminaires
f. Specialty outlets
g. Lighting standards (pole), such as
   - Parking lot lighting
   - Traffic lighting
   - Street lighting

4. Perform raceway fill calculations. 10%

a. CEC requirements
b. Surface
c. Under floor
d. Conduits
e. Cellular

5. Describe commercial loads and related CEC branch circuit calculations. 20%

a. Electric range
b. Electric dryer
c. Electric hot water tank
d. Electric space and surface heat and heating control requirements
   - Installation and maintenance
e. Special purpose outlets
f. Convenience outlets (lights, receptacles)
g. Automobile receptacle installations

6. Describe single conductor cable installations. 10%

a. CEC requirements
b. Paralleling requirements
c. Installation configurations
d. Perform related calculations

7. Describe single and three phase motor installations. 15%

a. CEC requirements
b. Commercial applications
c. Perform related calculations for single and groups of motors
   - Conductors
   - Overcurrent
   - Overload
   - Disconnecting means

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Apprenticeship Manitoba

Construction Electrician/Industrial Electrician/Power Electrician

Unit: B2 Commercial Code Applications

Level: Two

Duration: 60 hours

Theory: 45 hours

Practical: 15 hours

Overview:

This unit is designed to provide the apprentice with the skills for commercial code applications. The unit begins with coverage of emergency systems and single phase and three phase commercial service installations. Part of the unit covers commercial service calculations, blueprint use and single phase transformers. Finally, the unit covers installation techniques for conduit and tubing and Voice Data Video structured cabling systems.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Identify hazards and describe safe work practices pertaining to commercial code applications.	**5%**
2. Describe the installation and maintenance of emergency systems. a. CEC requirements b. Unit equipment (battery banks) c. Generators d. Uninterrupted power supply (UPS) e. Exit lighting and signage	**15%**
3. Describe single phase and three phase commercial service installations. a. CEC requirements b. Overhead c. Underground d. Customer service termination enclosures (CSTE) e. Remote metering f. Meter stacks g. Bonding and grounding requirements	**15%**
4. Perform commercial service calculations. a. CEC requirements b. Apartment blocks and row housing c. Other types of occupancies, including: • Storage warehouse • Office building • Retail stores	**20%**

5. Interpret and demonstrate use of blueprints for commercial applications. 10%

a. Symbols and terminology
b. Specifications
c. Riser and single line diagrams
d. Architectural, mechanical and electrical drawings

6. Demonstrate and perform conduit and tubing installation practices for commercial applications. 10%

a. Cutting
b. Bending
c. Threading
d. Deburring

7. Describe Cathodic protection. 5%

a. CEC requirements
b. Applications and operation
c. Testing and maintenance

8. Describe single phase transformers (extra low and low voltage). 15%

a. CEC requirements.
b. Commercial applications
c. Nameplate data (system voltages and currents, and kilo Volt-Amps (KVA)
d. Perform related calculations.
    - Conductors
    - Overcurrent
e. Installation and maintenance

9. Describe renewable energy systems. 5%

a. CEC requirements
b. Wind (turbines)
c. Solar (photovoltaic cells)
d. Tidal

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Apprenticeship Manitoba

Construction Electrician/Industrial Electrician/Power Electrician

Unit: B3 AC Fundamentals

Level: Two

Duration: 90 hours

Theory: 90 hours

Practical: 0 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about AC fundamentals. The unit begins with coverage of AC terminology and basic concepts, types of AC components and AC power. Part of the unit covers calculations for series, parallel and combination AC circuits. Finally, the unit covers power factor correction calculations.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Identify hazards and describe safe work practices pertaining to AC fundamentals.	**5%**
2. Define terminology and basic concepts related to sinusoidal alternating current (AC). a. AC voltage and current. • AC generation • Polarity • Waveform (frequency, time, degrees, radians) • Vector (phasor) relationship b. Perform related calculations • Instantaneous values • Average • Peak • Root mean squared (RMS)	**10%**
3. Describe types of AC components. a. Resistance • Effective b. Inductors • Inductance • RL time constants • Inductive reactance c. Capacitors • Capacitance • RC time constants • Capacitive reactance	**15%**

4. Describe AC Power. **15%**

a. Instantaneous, apparent, true and reactive power
b. Power measurement
c. Perform related power calculations
   - Apparent power
   - True power
   - Reactive power
   - Power factor

5. Describe and calculate series AC circuits. **20%**

a. Series AC circuit
   - Total impedance
   - Resistive inductive (RL)
   - Resistive capacitive (RC)
   - Resistive inductive capacitive (RLC)
   - Resonant circuits
b. Perform related calculations using
   - Ohm's Law, complex numbers, Kirchoff`s Voltage Law (KVL) and Voltage Divider Rule
c. Sketch the power triangle and use it to solve power problems
d. Power factor
e. Represent voltage and current relationships using vector (phasor) diagrams

6. Describe and calculate parallel AC circuits. **20%**

a. Parallel AC circuit
   - Total impedance
   - RL
   - RC
   - RLC
   - Resonant circuits
b. Perform related calculations using
   - Ohm's Law, complex numbers, Kirchoff`s Current Law (KCL) and Current Divider Rule
c. Sketch the power triangle and use it to solve power problems
d. Power factor
e. Represent voltage and current relationships using vector (phasor) diagrams

7. Describe and calculate combination AC circuits. **5%**

a. Combination AC circuit
   - Total impedance
   - RL
b. Perform related calculations
c. Sketch the power triangle and use it to solve power problems
d. Power factor
e. Represent voltage and current relationships using vector (phasor) diagrams

8. Describe and calculate power factor correction. **10%**

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Apprenticeship Manitoba

Construction Electrician/Industrial Electrician/Power Electrician

Unit: B4 Motor Controls

Level: Two
Duration: 70 hours
Theory: 40 hours
Practical: 30 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about motor controls. The unit begins with coverage of basic motor control and control devices. Part of the unit covers other motor control concepts, including relays, starters and timers. Finally, the unit covers schematic diagram interpretations and installation techniques.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Identify hazards and describe safe work practices pertaining to motor controls.	**5%**
2. Describe basic motor control. a. Purpose b. Safety hazards c. Types • Two wire control • Three wire control d. Motor control diagrams and symbols • Wiring • Schematics (line) • Conventions e. Overcurrent protection	**20%**
3. Describe control devices. a. Purpose b. Types • Pushbuttons • Selector switches • Pilot (end) devices, including float, flow, limit and pressure switches • Sensors, including flow and pressure c. Operation d. Ratings	**10%**
4. Describe overload relays. a. Purpose	**5%**

b. Types
   - Thermal
   - Magnetic
c. Operation
d. Ratings
e. Placement in power and control circuit

5. Describe contactors and motor starters. **10%**

a. Purpose
b. Types
   - National Electrical Manufacturers Association (NEMA)
   - International Electrotechnical Commission (IEC)
c. Operation
d. Components and terminal markings
e. Ratings
   - Contact (load and auxiliary)
   - Coil
f. Reversing starter
   - Mechanical interlocking
   - Electrical interlocking
g. Control transformers

6. Describe control relays and timers. **10%**

a. Purpose
b. Operation
c. Ratings
   - Coil
   - Contact
d. On delay / Off delay

7. Design and interpret schematic diagrams for motor controls. **20%**

a. Pushbuttons and selector switches
b. Pilot devices

8. Perform installation, testing, troubleshooting and maintenance techniques using schematic or wiring diagrams. **20%**

a. Control projects, including:
   - Stop and start
   - Jogging
   - Reversing
   - Sequence
   - Timing
b. Testing, troubleshooting and maintenance techniques
   - Meter selection and placement
   - Meter reading
   - Logical testing procedure
c. Startup and shutdown procedures
d. Commissioning and decommissioning

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Apprenticeship Manitoba

Construction Electrician/Industrial Electrician/Power Electrician

Unit: B5 Electronic Concepts I

Level: Two

Duration: 40 hours

Theory: 30 hours

Practical: 10 hours

Overview:

This unit is designed to provide the apprentice with introductory knowledge about electronic concepts. The unit begins with coverage of semiconductors and diodes. Part of the unit covers rectification, filtering and voltage regulation. Finally, the unit covers application of electronic concepts.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Identify hazards and describe safe work practices pertaining to electronic devices and meters.	**5%**
2. Describe semiconductors. a. Atomic structure b. Temperature effects c. P and N type materials (majority and minority carriers)	**10%**
3. Describe diodes. a. Purpose and applications b. Types • Junction diode • Light emitting diode (LED) c. Schematic symbols • Anode • Cathode d. Conductivity • Forward bias • Reverse bias e. Operating characteristics • Characteristic curves • Voltage drop	**25%**
4. Describe rectification. a. Purpose and applications b. Types • Half wave	**25%**

- Full wave
- Full wave bridge

c. Performs related calculations

5. Describe filtering. **5%**

a. Purpose and applications
b. Types
   - Capacitors
   - Inductors
c. Performs related calculations

6. Describe voltage regulation. **10%**

a. Purpose and applications
b. Zener diode
   - Schematic symbol
   - Terminal connections
   - Breakdown region (reverse voltage)
   - Power dissipation
c. Purpose of current limiting resistor
d. Performs related calculations

7. Demonstrate and apply electronic concepts. **20%**

a. Use an oscilloscope to measure various AC and DC voltages
b. Test a diode
   - Ohmmeter
   - Digital diode tester
c. Measure the voltages in filtered and unfiltered circuits
d. Measure the voltages in a regulated circuit
e. Troubleshoot common rectifier power supply malfunctions

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Apprenticeship Manitoba

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Unit: B6 DC Machines and Controls

Level: Two

Duration: 30 hours

Theory: 25 hours

Practical: 5 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about DC machines and controls. This unit covers DC generators, DC motors and motor controls.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Identify hazards and describe safe work practices pertaining to DC machines and controls.	**5%**
2. Describe installation and maintenance of DC generators. a. Types • Series • Shunt • Compound • Permanent magnet • Separately excited b. Purpose and applications c. Operating characteristics d. Armature reaction e. Voltage regulation f. Voltage control g. Terminal markings and schematics h. Commutation i. Field excitation j. Perform related calculations	**40%**
3. Describe installation and maintenance of DC motors a. Types • Series • Shunt • Compound • Permanent magnet • Separately excited b. Purpose and applications	**40%**

c. Operating characteristics
   - Field loss for a shunt
   - Load loss for a series
   - Above and below speed control
   - Speed regulation
   - Reversing the direction of rotation

d. Armature reaction
e. Terminal markings and schematics
f. Hazards associated with differentially compounded DC motors
g. Perform related calculations

4. Describe and demonstrate installation and maintenance of DC motor controls. 15%

a. Across the line starting methods used for DC motors
b. Various methods for controlling armature in rush current
c. Purpose of shunt field failure relays
d. Connect control and power circuits for DC motors that incorporate:
   - Across the line starting
   - Definite time acceleration
   - Counter electromotive force (EMF) acceleration
   - Above and below normal speed control

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