Industrial Electrician

Unit: D1 Electrical Code IV

Level: Four
Duration: 50 hours
 Theory: 45 hours
 Practical: 5 hours

Overview:
This unit of instruction is designed to provide the Industrial Electrician apprentice with knowledge and understanding of the Canadian Electrical Code. On satisfactory completion, the apprentice-learner will be able to describe relevant CE Code regulations, calculate minimum conductor ampacities and overcurrent protection for motors, transformers, welders, capacitors, lighting systems, and electric heating, describe hazardous locations, cathodic protection, seismic restraint systems, and high voltage splicing methods. The apprentice-learner will also apply code regulations where applicable.

Objectives and Content:

<table>
<thead>
<tr>
<th>Objective</th>
<th>Percent of Unit Mark (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe the CE Code regulations for grounding and bonding of electrical and non-electrical equipment.</td>
<td>10%</td>
</tr>
<tr>
<td>2. Calculate the minimum conductor ampacities for electrical equipment:</td>
<td>18%</td>
</tr>
<tr>
<td>a. Motors</td>
<td></td>
</tr>
<tr>
<td>b. Transformers</td>
<td></td>
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<tr>
<td>c. Welders</td>
<td></td>
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<tr>
<td>d. Capacitors</td>
<td></td>
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<tr>
<td>e. Lighting systems</td>
<td></td>
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<tr>
<td>f. Electric heating</td>
<td></td>
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<tr>
<td>3. Calculate and determine minimum overcurrent and/or overload protection for electrical equipment:</td>
<td>19%</td>
</tr>
<tr>
<td>a. Motors</td>
<td></td>
</tr>
<tr>
<td>b. Transformers</td>
<td></td>
</tr>
<tr>
<td>c. Welders</td>
<td></td>
</tr>
<tr>
<td>d. Capacitors</td>
<td></td>
</tr>
<tr>
<td>e. Lighting systems</td>
<td></td>
</tr>
<tr>
<td>f. Electric heating</td>
<td></td>
</tr>
<tr>
<td>4. Describe wiring methods for hazardous locations.</td>
<td>14%</td>
</tr>
<tr>
<td>5. Identify Cathodic Protection.</td>
<td>7%</td>
</tr>
</tbody>
</table>
6. Identify Seismic Restraint Systems. 7%
a. Wiring methods
7. Describe high voltage splicing methods. 11%
8. Describe Shock, Flash, and Blast Protection. 7%
9. Describe Emergency Stand By Systems. 7%
a. Manual and Automatic Transfer Switches
b. Wiring Methods

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Industrial Electrician

Unit: D2 Industrial Control Systems and Building Automation Systems

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

Overview:
This unit of instruction is designed to provide the Industrial Electrician apprentice with knowledge and understanding of Industrial Control (Microprocessor-based control and Monitoring) Systems and Building Automation Systems. On satisfactory completion, the apprentice-learner will be able to describe programmable logic controllers, input/output, I/O configuration, ladder diagrams, programming considerations, safe programming and wiring considerations, analog I/O, troubleshooting, distributed control systems, open/closed loop control systems, computer numerically controlled machines, instrumentation devices and calibration. The apprentice-learner will also be able to describe energy management, annunciation, HVAC, and fire alarm systems, microprocessor-based lighting controls, as well as identify devices, wiring methods, and addressable systems.

Objectives and Content:

1. Describe Programmable logic controllers.
   a. Describe the basic components of programmable logic controllers
   b. Describe Input/Output
      • Discrete I/O (Optical isolation, Power supplies)
      • Discrete, Analog, and specialty modules
      • Wiring methods (Bonding methods, Remoter I/O)
   c. Describe I/O configuration
      • Local (Fixed I/O, Modular I/O)
      • Remote (Distributed I/O, Distributed control systems (DCS))
   d. Describe and use ladder diagrams
      • Programming relay type instructions (System configuration, Address locations [external addresses, internal addresses], Documentation methods
      • Programming discrete inputs (Examine On, Examine Off, Transitional Contacts)
      • Programming Outputs (Discrete outputs, Logical/internal outputs, Latching relay instructions, Interposing relays)
      • Timers (Address locations, Preset and accumulated times, Time On and Time Off timers, Cascading)
      • Counters (Address locations, Preset and accumulated count, Count Up and Count Down counters)
   e. Describe programming considerations.
      • Memory limitations, Networks, Program scan, Nesting
   f. Describe safe programming and wiring considerations
      • Security (Key locks, software), Master control relay, Stop and emergency stop push buttons, Program documentation.

Percent of Unit Mark (%)

75%
g. Describe analog I/O (Analog I/O, Analog inputs, Analog outputs, Transducers and transmitters, Voltage and current sensing modules, Resolution/Scaling, Binary conversion, Wiring methods)

h. Demonstrate Troubleshooting Methods
   • Bonding Connections, Low and extra low voltage systems, Controller self diagnostics, LED indicators, Watch Dog Timer, Troubleshooting power supplies, Controller, I/O modules, Troubleshooting discrete modules, Overcurrent protection, LED indicators, Search functions, Force/Disable functions, Inputs, Outputs, Internal relays/Contacts.

i. Describe Distributed Control Systems:
   • Discrete, Analog, PI & PID Networks

j. Describe Open/Closed Loop Control Systems:

k. Describe Computer Numerically Controlled Machines:

l. Describe common instrumentation devices used to measure heat, weight, pressure, volume, flow and level.

m. Describe Instrumentation Calibration Methods:
   • Span, Resolution, Transducers, Transmitters

n. Apply principles/functions of programmable logic controls and control systems to practical work assignments.

2. Describe Building Automation Systems. 25%

   a. Describe Energy Management Systems
   b. Describe Annunciation Systems:
   c. Describe HVAC System
   d. Describe Fire Alarm Systems
   e. Describe microprocessor-based lighting controls
   f. Describe devices, wiring methods, addressable systems
   g. Apply building automation systems knowledge gained to practical work assignments

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Industrial Electrician

Unit: D3 Electronics III

Level: Four

Duration: 30 hours
  - Theory: 22 hours
  - Practical: 8 hours

Overview:

This unit of instruction is designed to provide the Industrial Electrician apprentice with knowledge and understanding of Electronics. On satisfactory completion, the apprentice-learner will be able to describe rectifier circuits, converter circuits, inverter circuits, transducers and transmitters and operational amplifiers.

Objectives and Content:

<table>
<thead>
<tr>
<th>Objective</th>
<th>Percent of Unit Mark (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe Rectifier Circuits.</td>
<td>7%</td>
</tr>
<tr>
<td>2. Describe Converter Circuits.</td>
<td>13%</td>
</tr>
<tr>
<td>3. Describe Inverter Circuits.</td>
<td>20%</td>
</tr>
<tr>
<td>4. Describe Transducers and Transmitters.</td>
<td>20%</td>
</tr>
<tr>
<td>5. Describe operational amplifiers.</td>
<td>13%</td>
</tr>
<tr>
<td>6. Apply electronic knowledge gained from this unit to practical work assignments.</td>
<td>27%</td>
</tr>
</tbody>
</table>

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Trade Name

Unit: D4 AC and DC Electronic Motor Drives

Level: Four
Duration: 30 hours
  Theory: 15 hours
  Practical: 15 hours

Overview:
This unit of instruction is designed to provide the Industrial Electrician apprentice with knowledge and understanding of AC & DC Electronic Motor Drives. On satisfactory completion, the apprentice-learner will be able to describe rectifier circuits, converter circuits, inverter circuits, and transducers and transmitters. The apprentice-learner will also be able to apply knowledge gained to practical work assignments.

Objectives and Content: Percent of Unit Mark (%)

1. Describe Electronic soft Starters. 10%
2. Describe AC Variable Frequency Drives. 17%
3. Describe DC Variable Speed Drives. 17%
4. Describe Wiring Methods. 6%
5. Apply knowledge gained to practical work assignments. 50%

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Industrial Electrician

Unit: D5 Preventive and Predictive Maintenance

Level: Four

Duration: 60 hours

Theory: 45 hours

Practical: 15 hours

Overview:

This unit of instruction is designed to provide the Industrial Electrician apprentice with knowledge and understanding of Preventive and Predictive Maintenance. On satisfactory completion, the apprentice-learner will be able to describe insulation testing, infrared thermography, computer managed maintenance systems, and maintenance, repairs and operation of electrical equipment. The apprentice-learner will also be able to apply knowledge gained to practical work assignments.

Objectives and Content:

<table>
<thead>
<tr>
<th>Percent of Unit Mark (%)</th>
</tr>
</thead>
</table>

1. Describe Insulation Testing. 8%

2. Describe Infrared Thermography:
   a. Motors, Transformers, Welders, Capacitors, Lighting systems, Electric heating. 2%

3. Describe Computer Managed Maintenance Systems. 5%

4. Describe Maintenance, Repairs and Operation of Electrical Equipment:
   a. Batteries, Motor Control System Components, High and Low Voltage Distribution and Generating Equipment, Motors, Generators, Transformers, Capacitors, OCP, OLP and GFP Devices, Metering, Drives, UPS's. 60%

5. Apply knowledge gained to practical work assignments. 25%
Industrial Electrician

Unit: D6 Unit Title

Level: Four
Duration: 30 hours
Theory: 24 hours
Practical: 6 hours

Overview:
This unit of instruction is designed to provide the Industrial Electrician apprentice with knowledge and understanding of Power Quality. On satisfactory completion, the apprentice-learner will be able to describe UPS systems, transient voltage surge suppression (TVSS), ground fault protection (GFP), harmonics, and mitigation methods. The apprentice-learner will also be able to apply knowledge gained to practical work assignments.

Objectives and Content:

1. Describe UPS Systems. 27%
2. Describe power quality issues. 7%
3. Describe Transient Voltage Surge Suppression (TVSS). 10%
4. Describe Ground Fault Protection (GFP). 10%
5. Describe Harmonics. 13%
6. Describe Mitigation Methods. 13%
7. Apply knowledge gained to practical work assignments. 20%

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Industrial Electrician

Unit: D7 Fluid Power Control Systems

Level: Four
Duration: 10 hours
  Theory: 4 hours
  Practical: 6 hours

Overview:
This unit of instruction is designed to provide the Industrial Electrician apprentice with knowledge and understanding of Fluid Power (Electrical) Control Systems. On satisfactory completion, the apprentice-learner will be able to describe basic hydraulic and pneumatic devices, solenoid activated valves, and servo valves. The apprentice-learner will also be able to apply knowledge gained to practical work assignments.

Objectives and Content:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Describe basic hydraulic and pneumatic devices.</td>
</tr>
<tr>
<td>2.</td>
<td>Describe solenoid activated valves.</td>
</tr>
<tr>
<td>3.</td>
<td>Describe servo valves.</td>
</tr>
<tr>
<td>4.</td>
<td>Apply knowledge gained to practical work assignments.</td>
</tr>
</tbody>
</table>

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Industrial Electrician

Unit: D8 Electrical Measuring Systems

Level: Four
Duration: 30 hours  
Theory: 15 hours  
Practical: 15 hours

Overview:

This unit of instruction is designed to provide the Industrial Electrician apprentice with knowledge and understanding of Electrical Measuring Systems. On satisfactory completion, the apprentice-learner will be able to describe and apply electrical measuring systems.

Objectives and Content:

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Describe electrical measuring systems.</td>
</tr>
<tr>
<td>2.</td>
<td>Apply electrical measuring systems to the trade.</td>
</tr>
</tbody>
</table>

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Industrial Electrician

Unit: D9 Provincial Electrical Requirements

Level: Four
Duration: 40 hours
  Theory: 40 hours
  Practical: 0 hours

Overview:

This unit offers senior apprentices a systematic review of skills and knowledge required to pass their journey-level Certification Exam. Unit content promotes a purposeful, personal synthesis between on-the-job learning and the content of in-school technical training. The unit includes information about the significance of occupational qualifications, and the main features of the Certification Exam, as well as practical strategies/resources for mastering study materials. This material on mastering study-materials accompanies a comprehensive and systematic review of prescribed, trade-specific program content. It is intended that apprentices who seriously tackle the objectives of this unit should be able to approach the Certification Exam with well-founded confidence. The unit also supports consolidation of study practices, trade knowledge, and self-awareness to help meet longer-term requirements of further learning throughout one’s career as a skilled worker.

Note: No percentage-weightings for test purposes are prescribed for this unit’s objectives. Instead, a ‘Pass/Fail” grade will be recorded for the unit in its entirety. A Pass mark is still assumed to be 70% and therefore 70% is the mark to be submitted to the Apprenticeship Manitoba clerks for inputting into the computer records.

Objectives and Content:

1. Describe the significance, format, and content of the Industrial Electrician Red Seal Certification Exam.
   a. Scope and aims of occupational qualification systems; value of certification
   b. Obligations/entitlements of candidates for certification
      • Relevance of Certification Exam on to current industry standards, practices, and expectations
      • Supplementals Policy (retesting)
      • Confidentiality of examination content; the candidate’s own stake in examination security (value of credential)
      • Limitations on use of calculators (e.g., dedicated, pre-programmed builders’ calculator not allowed)
   c. Multiple-choice (four-option) item format; common standards for acceptable test items (e.g. no “trick”-type questions; specifications for use of metric/Imperial units)
   d. Important government materials relevant to the Certification examination
      • National Occupational Analysis (NOA); prescribed scope of the skills and knowledge which comprise the trade
      • Special significance of subtask-level NOA descriptors re: exam content
   e. Other (specified by instructor)
2. Identify resources, strategies, and other key considerations for maximizing successful completion of certification exams in the construction-sector.
   a. Personal preparedness
      • Proper rest/nutrition; eye-testing
      • Making room for a personal study regimen: appropriate prior communication with family members, friends, and employers about exam-related commitments/needs; identifying – and concluding – all necessary arrangements for minimizing distractions/disruptions
      • Focused reflection on prior experience – good and bad – in test situations (e.g. Unit Tests), especially with respect to what the trainee already has learned re: personal characteristics, learning styles, exam anxiety, and strategies (e.g. time management) for effective performance in test situations.
   b. Self-assessment, consultation, and a Personal Study Plan
      • Preliminary self-assessment of individual strengths/weaknesses in trade-related skills and knowledge; usefulness of old tests and training program materials; personal reflection re: in-school and on-the-job components of the program, as well as the relationship between these two components; usefulness of consultation with trainer(s), instructor(s), appropriate peers, the Training Coordinator, and/or personal mentors and skills-coaches
      • Use(s) of approved textbooks, chapter tests, study guides, and note-taking in preparing for an examination
      • Study groups: perils and possibilities
      • Formulation, and submission for instructor’s comments, of a personal study plan, including an approximate timetable, which describes/schedules a course of action for reviewing all relevant material(s) and for strengthening areas of deficient skills/knowledge in anticipation of the Certification Exam
   c. Other (specified by instructor)

3. Review program content re: D.C.
   a. Ohm’s Law
   b. Resistance of wires and power calculations
   c. Generators and motors
   d. Controls
   e. Instruments

4. Review program content re: A.C.
   a. Resistance, inductance and capacitance in A.C.
   b. Transformers
   c. Meters and Instruments
   d. Alternators and motors

5. Review program content re: Code.
   a. Formulas and calculations
   b. Major rule interpretations
   c. General table review
   d. General section recognition.

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