Grades 9 to 12 Electrical Trades Technology

Manitoba Technical-Vocational Curriculum Framework of Outcomes

Manitoba

Grades 9 to 12
Electrical Trades Technology

Manitoba Technical-Vocational Curriculum
Framework of Outcomes

2018
Manitoba Education

Manitoba Education Cataloguing in Publication Data

Grades 9 to 12 electrical trades technology : Manitoba
technical-vocational curriculum framework of outcomes

Includes bibliographical references.
ISBN: 978-0-7711-7684-5 (pdf)

1. Electricians—Vocational guidance.
2. Electrical engineering—Study and teaching (Secondary)—Manitoba.
3. Electric industry workers—Study and teaching (Secondary)—Manitoba.
4. Technical education—Manitoba—Curricula.
5. Vocational education—Manitoba—Curricula.
I. Manitoba. Manitoba Education.
621.30712

Manitoba Education
Winnipeg, Manitoba, Canada

Any websites referenced in this resource are subject to change without notice. Educators are advised to preview and evaluate websites and online resources before recommending them for student use.

This resource is available on the Manitoba Education website at www.edu.gov.mb.ca/k12/cur/teched/sy_tech_program.html.

Available in alternate formats upon request.

Contents

Acknowledgements

Manitoba Education gratefully acknowledges the contributions of the following individuals in the development of *Grades 9 to 12 Electrical Trades Technology: Manitoba Technical-Vocational Curriculum Framework of Outcomes*.

2018 Revisions	Gary Yakimoski	Sturgeon Heights Collegiate St. James-Assiniboia School Division
Members of the 2014 Development Team	Kent Brewer	Kildonan East Collegiate River East Transcona School Division
	Dominik Meiler	Kildonan East Collegiate River East Transcona School Division
	Jim Turner	Swan Valley Regional Secondary School Swan Valley School Division
	Gary Yakimoski	Sturgeon Heights Collegiate St. James-Assiniboia School Division
	Gerry Levesque	Steinbach Regional Secondary School Hanover School Division
	Doug Macintosh	Selkirk Regional Secondary School Lord Selkirk School Division
	Rob Vandendorpe	Red River College

Manitoba Education Staff

Louise Boissonneault Coordinator	Document Production Services Unit Instruction, Curriculum and Assessment Branch
John Finch Coordinator	Learning Support and Technology Unit Instruction, Curriculum and Assessment Branch
Lynn Harrison Desktop Publisher	Document Production Services Unit Instruction, Curriculum and Assessment Branch
Gilles Landry Project Leader	Learning Support and Technology Unit Instruction, Curriculum and Assessment Branch
Grant Moore Publications Editor	Document Production Services Unit Instruction, Curriculum and Assessment Branch
Kim Poirier Consultant	Learning Support and Technology Unit Instruction, Curriculum and Assessment Branch

Technical-Vocational Education Overview

In 2013, Manitoba Education released the document *Technical-Vocational Education Overview*, available at www.edu.gov.mb.ca/k12/cur/teched/sy_tech_program.html, to provide the philosophical and pedagogical underpinnings for curriculum development and the teaching of technical-vocational education (TVE) courses in Manitoba. This overview presents educators with the vision and goals of TVE in Manitoba.

Topics include the following:

- curriculum revitalization and renewal
- curriculum framework and implementation
- articulation of programming
- assessment and reporting
- safety
- employability/essential skills and career development
- sustainable development

TVE clusters of courses are designed to encourage students to explore career options in designated trades and trained occupations, and to address labour shortages in these areas. The TVE curriculum includes course clusters for both *designated trades* (trades designated for apprenticeship training and certification by Apprenticeship Manitoba) and *trained occupations* (those not designated as trades).

The TVE curriculum is significantly different from other subject areas, such as industrial arts. It has distinctive qualities that, when respected, will provide students with a uniquely valuable experience that they cannot receive from any other curriculum.

TVE gives students the opportunity to learn, from industry-certified teachers with industry experience, the theoretical and practical aspects of one specific trade or trained occupation in order to facilitate their transition from school to work or to post-secondary education in that trade or trained occupation (including journeyperson status from Apprenticeship Manitoba), or into an associated trade or occupation. This transition is accomplished by having students complete an entire TVE cluster of courses in a setting that, as much as possible, emulates an actual workplace.

TVE curriculum includes Grades 9 to 12 courses in a variety of areas, including electrical trades technology.

Electrical Trades Technology Overview

Grades 9 to 12 Electrical Trades Technology: Manitoba Technical-Vocational Curriculum Framework of Outcomes identifies the goals, general learning outcomes (GLOs), and specific learning outcomes (SLOs) for nine electrical trades technology courses. This framework is intended for use in all Manitoba schools teaching electrical trades technology as part of the Senior Years Technology Education Program.

Electrical Trades Technology as a TVE Cluster

Grades 9 to 12 Electrical Trades Technology: Manitoba Technical-Vocational Framework of Outcomes has been developed as a technical-vocational education (TVE) cluster of courses.

The electrical trades technology curriculum prepares students for a career as industrial electricians, power electricians, or construction electricians, which have been designated as trades by the regulations under the *Apprenticeship and Certification Act* (Manitoba), and is administered by Apprenticeship Manitoba. For more information on trade programs, refer to "Manitoba Trades" on the Apprenticeship Manitoba website at www.manitoba.ca/wd/apprenticeship/discover/mbtrades/index.html.

Like all other TVE courses, the electrical trades technology courses should be taught only as part of a complete cluster, approved by Manitoba Education and Training.

Revisions to the Electrical Trades Technology Curriculum

During the 2016/2017 school year, revisions were made to the curriculum in order to reflect the changes to *Construction Electrician/Industrial Electrician/Power Electrician Common Core Level 1* technical training from Apprenticeship Manitoba. This document had undergone revisions as part of the National Harmonization Initiative, which aligned Red Seal trades training across Canada. This 2018 version of the electrical trades technology high school curriculum reflects the changes made as a result of the harmonization initiative.

Role of Electricians

Apprenticeship Manitoba has designated three electrical trades: industrial electrician, power electrician, and construction electrician. It describes each of their roles as follows:

- A **construction electrician** plans, assembles, installs, repairs, tests, and maintains electrical fixtures and systems that provide heat, light, power, or control in residential, commercial, and industrial buildings.

  Construction electricians ensure that the electrical apparatus and systems people at home and in business depend on every day are safe and operate properly. Electricians also troubleshoot and repair or reinstall electrical systems when required. They must have the experience to safely remove electrical services and systems, as well as assess the suitability of existing

services for future use. Many electricians specialize in specific types of installations, such as new home construction or in the commercial and industrial sectors in hospitals or factories. (Apprenticeship Manitoba, "Construction Electrician")

- An **industrial electrician** plans, installs, tests, inspects, troubleshoots, and services all types of industrial electrical equipment vital to the operation of commercial and industrial businesses. These include all equipment or components directly or indirectly exposed to electric power, such as motors, generators, pumps, lighting systems, and associated electrical and electronic controls. They also do preventive maintenance and keep maintenance records. Industrial electricians are employed by electrical contractors, government, and maintenance departments in factories, plants, or mines. (Apprenticeship Manitoba, "Industrial Electrician")
- A **power electrician** is certified to install, test, repair, and maintain electrical apparatuses in generating and converter stations and substations. This equipment is used to generate, transmit, distribute, and convert electricity. One very important requirement of this trade, in addition to the technical knowledge, is the need to observe and practise safety at all times because of the hazards and dangers associated with electricity. Power electricians work both inside and outside buildings and structures such as thermal and hydraulic generating stations, substations, and other utility-owned buildings. Maintenance work takes place on the ground and at various heights requiring bucket-truck or ladder work. Power electricians are employed by electrical utility companies such as Manitoba Hydro. (Apprenticeship Manitoba, "Power Electrician")

Career and Employment Opportunities in Electrical Trades Technology

Level 1 for each of the three electrical trades (industrial, power, and construction) has a common core. For more information, see the Apprenticeship Manitoba trade profiles at www.gov.mb.ca/wd/apprenticeship/discover/mbtrades/index.html.

Every objective in the common core technical training document has been incorporated into this curriculum. Most courses are composed of outcomes related to the design and installation of electrical systems.

A student graduating from the high school electrical trades technology program can seek entry-level employment as an apprentice electrician. In order to be qualified and to continue as an electrician, students must seek apprenticeship and continue post-secondary training. Electrical trades technology graduates are typically employed by electrical contractors, the military, manufacturing facilities, maintenance contractors, wholesale electrical suppliers, and utilities. They also have the option of self-employment after completing their apprenticeship.

The electrical trades technology program provides a foundation for students to move into an apprenticeship position once employed. Students graduating from the high school electrical trades technology program will also have a foundation to enter post-secondary education in civil engineering technology or electrical engineering.

Graduates of the electrical trades technology program will be able to demonstrate the following:

- basic installation of electrical systems
- complete documentation
- troubleshooting of electrical systems
- modern wiring techniques
- communication and collaboration with peers and supervisors
- critical thinking and decision-making skills
- working independently or as part of a team
- time management skills
- mechanical aptitude and manual dexterity
- problem-solving skills
- employability skills

Implementation of the Electrical Trades Cluster

To be eligible to receive a Senior Years Technology Education Program (SYTEP) diploma from Manitoba Education and Training, a student must complete a minimum of eight departmentally developed required courses to a maximum of 14 credits. The grade level in which the courses are offered are a local school-based decision, but it is highly recommended that the sequencing of credits follow the schedule set out in this curriculum.

Cross-curricular learning outcomes include essential skills from subject areas including, but not limited to, information and communication technologies, physics, English language arts, and mathematics and are to be integrated into the authentic activities of the course. Outcomes dealing with the following topics are also integrated into most courses:

- health and safety
- sustainability
- ethical and legal standards
- employability skills
- working conditions and career opportunities
- evolution, technological progression, and emerging trends

Most courses are composed of learning outcomes related to the design and installation of electrical systems, and the emphasis is on applied activities. For instructional purposes, the sequence of outcomes can vary based on the activities within the course. Teachers are advised to select the activities

best suited to teach the outcomes, based on a variety of factors, including access to resources or regional needs.

1. The curriculum is not sequential. In other words, outcomes might be taught in an order different from how they appear in the document.
2. In light of rapid changes in technology, teachers are encouraged to update their activities in order to meet the needs of students and industry.

Level 1 Apprenticeship for Construction Electrician, Industrial Electrician, and Power Electrician

Electrical trades technology programs delivering the eight high school courses (that do not include the Grade 9 course), which contain the eight mandatory Apprenticeship Manitoba courses, may be eligible for accreditation with Apprenticeship Manitoba. This is because

- this cluster is taught only by journeyperson electricians
- the curriculum includes all of the objectives from *Construction Electrician/Industrial Electrician/Power Electrician Common Core Level 1* from Apprenticeship Manitoba

For more information on accreditation, see "Information for Instructors and Educators" on the Apprenticeship Manitoba website at www.gov.mb.ca/wd/apprenticeship/generalinfo/instructoreducators.html.

In addition to including all of the Level 1 Apprenticeship objectives, the courses also include learning outcomes related to the following:

- AC fundamentals, including magnetism and electromagnetism
- alternative wiring methods and their Canadian Electrical Code (CEC) codes
- various raceways and cables
- home automation technologies
- service and demand load calculations
- motor controls
- PLCs
- retrofitting and/or upgrading existing electrical installations

These outcomes were added so that students would have a more complete and authentic introduction to the trade.

The Multi-Course and Individual-Course Formats

This curriculum has been developed in two different formats. The **multi-course format** (found in this document) is comprised of either five columns (one course each in Grades 9 and 10, and three in Grade 11) or four columns (the four Grade 12 courses). It is found in this document, starting on page 15.

The **individual-course files** are made up of one course per file. Those nine files are found at www.edu.gov.mb.ca/k12/cur/teched/sytep/electrical/index.html.

The multi-course and individual-course formats have been developed for different reasons and serve different purposes. The most important difference is that the multi-course files (containing four or five columns) **do not contain all of the content**. Specifically, while they contain all of the specific learning outcomes (SLOs), they **do not contain all of the detailed content** associated with each SLO. That detailed content is found only in the individual-course files. Therefore, **teachers need to use the individual-course files**.

The multi-course format does not contain all of the content simply because there is not enough room for it. If it were to contain all of the content, some individual SLOs and their content would fill a narrow column for several pages, making them impossible to read.

However, teachers find the multi-course format very useful, because it allows them to compare the four or five courses listed there, and to see how students progress from one course to the next within each goal and general learning outcome.

The SLOs in this curriculum that correspond with the Apprenticeship Manitoba objectives from *Construction Electrician 1* or *Industrial Electrician 1* or *Power Electrician 1* (Level 1 for these three trades is identical) have an alpha-numeric code at the end, which indicates the unit and objective from which they were taken.

Here is an example of an SLO and its content taken from *Construction Electrician 1*. 9062 Applied Electrical Trades Technology includes the following SLO 12D.1.1.1:

> 12D.1.1.1 "Describe the structure and scope of the construction electrician, industrial electrician, and power electrician trades. (A1.1)"

A1.1 indicates that the SLO is Objective 1 from Unit A1 Learning about Work, from page 1 of *Construction Electrician* or *Industrial Electrician* or *Power Electrician Level 1*: www.gov.mb.ca/wd/apprenticeship/pdfpubs/pubs/discover/mb_trades/construction_electrician/const_elec_lev1.pdf. The Level 1 document also includes the following essential content:

These details are a necessary part of this curriculum. So, when teaching this SLO, teachers must ensure that they are covering each point listed. Teachers also need to become familiar with the Carpenter documents from Apprenticeship Manitoba. These documents provide invaluable background to this curriculum, and are found at www.gov.mb.ca/wd/apprenticeship/discover/mbtrades/plumber.html.

1. **Describe structure and scope of the construction electrician, industrial electrician, and power electrician trades.** **n/a**
   a. ***The Apprenticeship and Certification Act***
      - Apprenticeship and Certification Board and Provincial Advisory Committees
      - General and specific trade regulation

- Policies regarding attendance, evaluation procedures, conduct, and progression requirements (Apprenticeship Manitoba, Training provider)

b. **Uses of the Red Seal Occupational Standard (RSOS) for Construction Electrician and Industrial Electrician or the Provincial Occupational Analysis (POA) for Power Electrician**

- Technical training in-school curriculum
- On-the-job record book of hours (Manitoba blue book)
- Logbook of on-the-job task competencies
- Examinations (level placement tests, final certification examinations)

c. **Opportunities and future career options**

- Generalists and specialists: The move toward specialization is well known to modern tradespeople. Some prefer to specialize and others want to do it all. Supervisory positions require a broad scope.
- Lead hands and other immediate supervisors. Apprentices need to know how to become a lead hand as much as they need to know the benefits and pitfalls of leadership between management and shop floor workers.
- Geographic mobility: What does it mean to a construction/industrial worker to have to travel to find work? Are there more opportunities if they do? What are they? What are the drawbacks to being away from home for several weeks at a time?
- Job hierarchies and innovations: What trade-specific special training opportunities are available in your trade? Is there travel involved? Is there an opportunity to move up the ladder on a work crew as opposed to staying in the shop?

The SLOs in this curriculum that are identical to the Apprenticeship Manitoba objectives from Common Core Level 1 have an alpha-numeric code at the end, which indicates the unit and objective from which they were taken. For example, the following SLO is found under GLO 9.1 of 9062 Applied Electrical Trades Technology:

> "Describe structure and scope of the construction electrician, industrial electrician, and power electrician trades. (A1.1)"

The A1.1 code indicates that the SLO is Objective **1** from Unit **A1**: Learning About Work, which is found on page 2 of *Construction Electrician / Industrial Electrician / Power Electrician – Level 1*.

To make *Grades 9 to 12 Electrical Trades Technology* easier to read, the SLOs do not include all of the detailed information for each Apprenticeship Manitoba objective. For example, for objective A1.1, *Construction Electrician/Industrial Electrician/ Power Electrician – Level 1* also includes the following

essential details, not found in this electrical trades technology curriculum:

These details are a necessary part of this curriculum. So, when teaching this SLO, teachers must ensure that they are covering each point listed. Teachers also need to become familiar with the Electrician documents from Apprenticeship Manitoba. These documents provide invaluable background to this curriculum, and are found at www.gov.mb.ca/wd/apprenticeship/discover/mbtrades/constructionelectrician.html.html.

Unit to Course Comparison (UCC) Form

Electrical trades technology teachers should refer to the document entitled *Unit to Course Comparison (UCC) Form – Construction Electrician/Industrial Electrician/ Power Electrician – Level 1*, available on the Apprenticeship Manitoba website at www.manitoba.ca/wd/apprenticeship/discover/mbtrades/constructionelectrician.html.

This form lists under which learning outcome each apprenticeship objective is taught in this high school curriculum. Teachers might find this document helpful in applying to have their courses accredited with Apprenticeship Manitoba.

Trade Safety Awareness Manual

Apprenticeship Manitoba has developed a Trade Safety Awareness Unit, the purpose of which is to increase student awareness of trade safety in the workplace. The unit is comprised of 20 learning outcomes, which are numbered from TSA 1 to TSA 20. Everybody who studies a trade must complete this seven-hour unit.

Five of the learning outcomes (TSA 13, 16, 18, 18 & 20) from the Trade Safety Awareness Unit are incorporated into GLO 1.1 of all courses. The remaining 15 learning outcomes are incorporated in GLO 1.2 of course 9055 Introduction to Electrical Trades Technology 20S/20E/20M and course 9061 Advanced Electrical Wiring Methods 40S/40E/40M. The Trade Safety Awareness Unit's alphanumeric designations are located at the end of the applicable SLOs in this framework.

For example, the following learning outcome is found in course 9055 Introduction to Electrical Trades Technology 20S/20E/20M and course 9061 Advanced Electrical Wiring Methods 40S/40E/40M:

"Define workplace safety and health hazards. (TSA 7)"

The *TSA 7* code indicates that this SLO is taken from Apprenticeship Manitoba's Trade Safety Awareness Unit.

For more information and to access the Trade Safety Awareness Unit and its tests and other resources, see "Information for Instructors and Educators" on the Apprenticeship Manitoba website at www.gov.mb.ca/wd/apprenticeship/generalinfo/instructoreducators.html.

Also see Instructor Trade Safety Awareness Manual at www.gov.mb.ca/wd/apprenticeship/pdfpubs/pubs/general/trade_safety/instructor.pdf.

Red Seal Resources

Because construction electrician and industrial electrician are designated Red Seal trades across Canada, the Apprenticeship Manitoba curriculum is aligned with the Canada-wide Red Seal curriculum. High school electrical trades technology teachers, as well as students working towards their Level 1 apprenticeship for electrician, can find valuable resources on the Red Seal website.

Industrial electrician:
www.red-seal.ca/trades/.3nd.5str.3.1l_.2l.2ctr.3c-eng.html

Construction electrician:
www.red-seal.ca/trades/c.4nst_.2l.2ctr.3c-eng.html

Among other resources, teachers and students can find sample examination questions used on Red Seal examinations.

Qualifications of Electrical Trades Technology Teachers

Only vocationally certified teachers are allowed to teach TVE courses, including the ones in this electrical trades technology cluster. Vocational certification includes three components:

1. **Trade Certification:** Electrical trades technology teachers need to have personally experienced the apprenticeship and journeyperson process so that they can share it with their students.
2. **Trade Experience:** Electrical trades technology teachers need to have been employed as electricians for at least six years (including their four-year apprenticeship). This will enable them to share their industry experience with students, which will, in turn, prepare them for working as electricians.
3. **Technical Vocational Teaching Certificate:** TVE teachers should have a technical vocational teaching certificate, obtained by completing Red River College's one-year Technical Vocational Teacher Education Diploma program. For information about this program, see http://me.rrc.mb.ca/Catalogue/ProgramInfo.aspx?RegionCode=WPG&ProgCode=TECVF-DP.

Employing only vocationally certified teachers to teach TVE courses preserves the integrity of TVE programming by ensuring that teachers are able to share their first-hand experience working in the trade, their familiarity with industry certification, and health and safety requirements. Students receive instruction from somebody who has been involved in that trade.

Apprenticeship Manitoba certifies TVE clusters offered in Manitoba schools only if they are taught by a vocationally certified teacher. Without a vocationally certified teacher, students' pathways to further study and careers are limited.

School boards risk significant liability if they employ non-vocationally certified teachers to teach TVE courses. Vocational certification confirms that a teacher has the requisite skills and knowledge to teach electrical trades technology safely, reducing the risk of accident and injury.

For further information, see "Professional Certification: Technical Vocational Teacher" on the the department's website at www.edu.gov.mb.ca/k12/cur/teched/docs/teacher-cert.pdf.

Comparison of Electrical Trades Technology with Industrial Arts Electricity/Electronics Technology

Like all TVE curricula, *Grades 9 to 12 Electrical Trades Technology: Manitoba Technical-Vocational Framework of Outcomes* has been developed to prepare high school students for a career in a specific trade, such as one of the electrical trades. It has not been developed as a general interest cluster of courses in electricity/electronics technology. Schools interested in teaching such a course are invited to teach the Industrial Arts curricula, which can be found on the department's website at www.edu.gov.mb.ca/k12/cur/teched/ind_arts.html.

Although electrical trades technology and industrial arts electricity/electronics curricula share some common content, they have been developed for completely different purposes and, therefore, are significantly different. The chart on the following page summarizes some of the differences between electrical trades technology (as a TVE cluster of courses) and electricity/electronics technology (as an industrial arts cluster of courses).

Electrical Trades Technology and Industrial Arts Electricity/Electronics Technology Comparison Chart

Frequently Asked Questions	TVE Electrical Trades Technology	Industrial Arts Electricity/Electronics Technology
1. Is the purpose of the curriculum to facilitate students' transition to the electrician trade?	Yes	No
2. Does the instruction try to emulate, as far as possible, a regular workplace?	Yes	No
3. Does the curriculum mandate employability skills such as punctuality and time management?	Yes	No
4. Is the teacher required to be a journeyperson electrician?	Yes	No
5. Is the teacher required to have experience working as a electrician?	Yes	No
6. Does the cluster prepare the student for certification as a journeyperson electrician?	Yes	No
7. Does the cluster focus on preparing the student for entry-level employment as a electrician after high school?	Yes	No
8. Is the teacher required to have a Manitoba general teaching certificate?	No	Yes
9. Is the teacher required to have a Manitoba technical vocational teaching certificate?	Yes	No
10. Do schools require special permission from Manitoba Education and Training to offer a cluster of courses?	Yes	No
11. Do schools have to offer all the courses in the cluster?	Yes	No
12. Do the clusters focus on **only one** trade or trained occupation?	Yes	No
13. Can schools offer hybrid clusters, made up of courses from several clusters?	No	Yes
14. Will students receive a Senior Years Technology Education Program diploma when they complete a cluster of courses?	Yes	No

Curriculum Goals and General Learning Outcomes

The learning outcomes for each course in the electrical trades technology cluster are based on the following curriculum goals and general learning outcomes (GLOs). **Please note that some courses do not address all of these goals and GLOs.**

Goal 1: Describe and apply **health and safety** practices.

- **GLO 1.1:** Describe and apply **health and safety** practices.
- **GLO 1.2:** Demonstrate awareness of electrical safety as it pertains to the ***Trade Safety Awareness Manual***.

Goal 2: Demonstrate the safe and appropriate **identification, selection, operation, maintenance, and management of equipment and tools.**

- **GLO 2.1:** Demonstrate the safe and appropriate **identification, selection, operation, maintenance, and management of equipment and tools**.

Goal 3: Demonstrate the safe and appropriate **identification, selection, installation, maintenance, and management of devices and materials.**

- **GLO 3.1:** Demonstrate the safe and appropriate **identification, selection, installation, maintenance, and management of devices and materials.**

Goal 4: Demonstrate an understanding of **electrical theory (fundamentals)**.

- **GLO 4.1:** Demonstrate an understanding of **electrical theory**.

Goal 5: Demonstrate an understanding of the **design, layout, and interpretation of branch circuits and systems.**

- **GLO 5.1:** Demonstrate an understanding of the **design, layout, and interpretation of branch circuits and systems**.

Goal 6: Demonstrate the procedures used to **install and terminate branch circuits and systems**.

- **GLO 6.1:** Demonstrate the procedures used to **install and terminate branch circuits and systems**.

Goal 7: Demonstrate an understanding of the **testing, troubleshooting, and documentation of branch circuits and systems**.

- **GLO 7.1:** Demonstrate an understanding of the **testing, troubleshooting, and documentation of branch circuits and systems**.

Goal 8: Describe and demonstrate the transferable **cross-curricular** knowledge and skills.

- **GLO 8.1:** **Read, interpret, and communicate** information.
- **GLO 8.2:** Apply the knowledge and skills from **mathematics**.
- **GLO 8.3:** Apply the knowledge and skills from the **sciences**.
- **GLO 8.4:** Apply the knowledge and skills from **information and communication technology**.

Goal 9: Understand **career opportunities and working conditions**.

- **GLO 9.1:** Describe **apprenticeship, education, career opportunities, professional organizations, and working conditions** related to electrical trades technology and associated fields.

Goal 10:	Demonstrate awareness of **sustainability**.
GLO 10.1:	Describe the impact of **human sustainability** on the health and well-being of tradespersons working in the electrical trades and those who use their services.
GLO 10.2:	Describe the electrical trade's **sustainability practices and impact on the environment**.
GLO 10.3:	Describe **sustainable business practices** within the electrical trades.
Goal 11:	Demonstrate an awareness of the **ethical and legal standards** as they pertain to the electrical trades.
GLO 11.1:	Demonstrate awareness of **ethical and legal standards**.
GLO 11.2:	Demonstrate understanding of **electrical codes**.
Goal 12:	Demonstrate **employability skills**.
GLO 12.1:	Demonstrate fundamental **employability skills**.
GLO 12.2:	Demonstrate an awareness of **cultural competence** and its importance in the workplace.
GLO 12.3:	Demonstrate an understanding of the **business operation** of an electrical trades facility.
GLO 12.4:	Demonstrate **critical thinking skills** in planning, procedures, analysis, and diagnosis.
Goal 13:	Understand the **evolution, technological progression, and emerging trends** in the electrical trades.
GLO 13.1:	Understand the **evolution, technological progression, and emerging trends** in the electrical trades.

Specific Learning Outcomes (SLOs)

Grades 9 to 12 Electrical Trades Technology: Manitoba Technical-Vocational Curriculum Framework of Outcomes identifies specific learning outcomes (SLOs) for use in all Manitoba schools teaching the Grades 9 to 12 electrical trades technology courses as part of the Senior Years Technology Education Program. SLO statements define what students are expected to achieve by the end of a course.

It is essential for students to learn and to demonstrate safety practices and employability skills; therefore, some SLOs related to safety and to employability skills are repeated in all courses.

Please note that SLOs are not identified for the goals and GLOs that are not addressed in a given course.

Course Descriptions

Course titles, descriptions, and codes for the electrical trades technology courses follow. For an explanation of the codes, refer to the *Subject Table Handbook: Technology Education* (Manitoba Education and Training), available at www.edu.gov.mb.ca/k12/docs/policy/sthte/index.html.

9054 Exploration of Electrical Trades Technology

15S/15E/15M
10S/10E/10M

This is an optional course intended for students wishing to sample the electrical trades. The emphasis is on hands-on activities. Students are introduced to safety, tools, and equipment for electrical/electronic systems.

9055 Introduction to Electrical Trades Technology

20S/20E/20M

Students will be introduced to basic electrical concepts. They will begin to design and wire circuits. Students are introduced to safety, tools, and equipment for electrical/electronic systems.

9056 Electrical Trades DC Fundamentals

30S/30E/30M

Students will be introduced to electrical/electronics technology by studying DC circuit theory. Areas of study include instrumentation, measurement, component recognition, value determination, and fabrication. Students will learn Ohm's law as it relates to series, parallel, and combination circuits.

9057 Residential Wiring — 30S/30E/30M

Students will be introduced to Canadian Electrical Code (CEC) standards. They will learn to design, install, test, and troubleshoot branch circuits, and become familiar with the tools, techniques, materials, and devices associated with it. Students will also be introduced to blueprint reading.

9058 Electrical Wiring Methods — 30S/30E/30M

Students will be introduced to alternative wiring methods and the CEC codes associated with them. They will work with various types of raceways and cables, and become familiar with the tools, techniques, materials, and devices associated with them.

9059 Advanced Residential Wiring 40S/40E/40M

Students will build on the knowledge and skills that they learned in residential wiring, including home automation technologies, and service and demand load calculations.

9060 Electrical Trades AC Fundamentals 40S/40E/40M

Students will become familiar with AC theory, including electrical fundamentals, magnetism, electromagnetism, and RLC circuits. Students will also focus on cross-curricular knowledge from mathematics and physics.

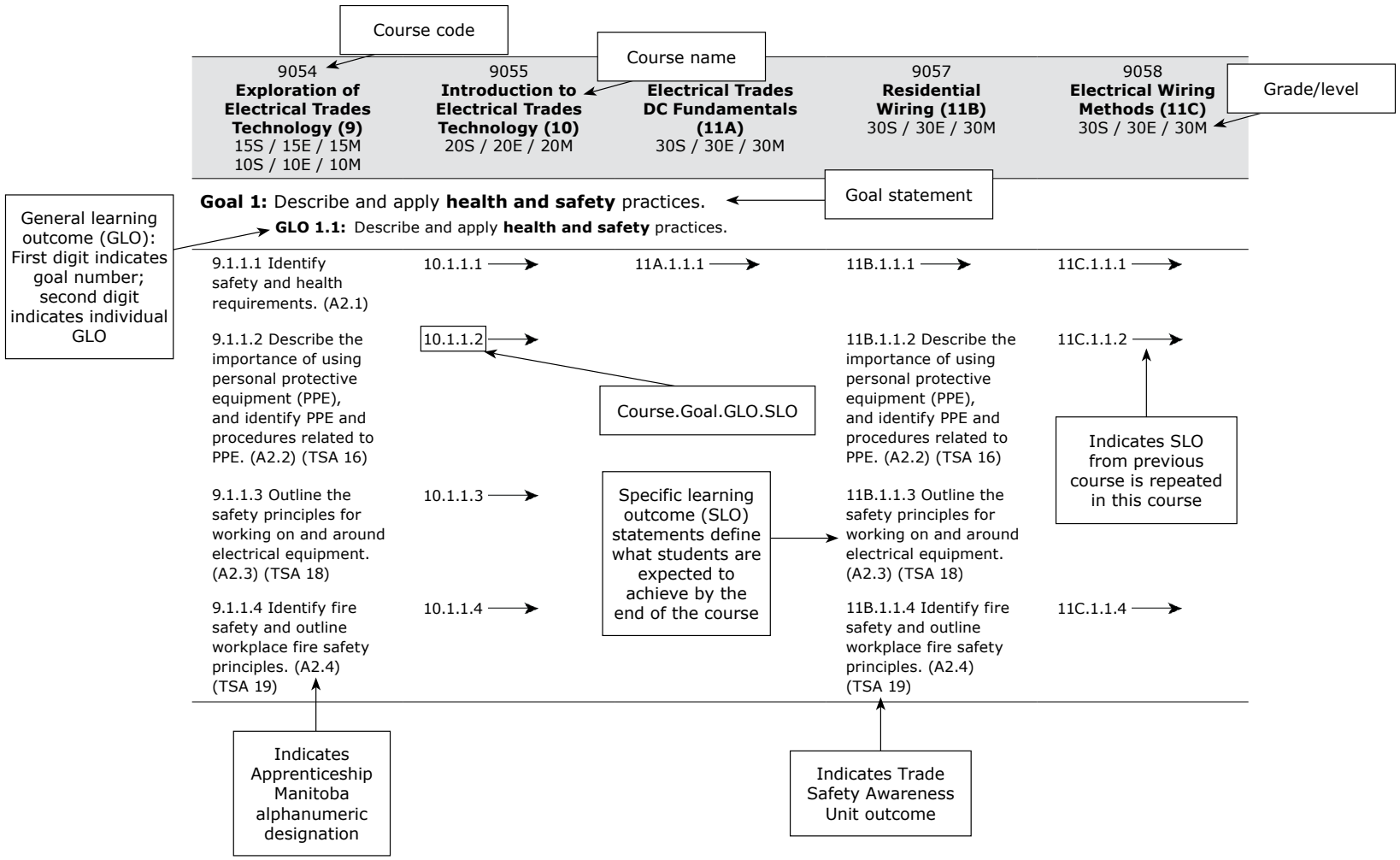
9061 Advanced Electrical Wiring Methods 40S/40E/40M

Students will build on the knowledge and skills that that they learned in Electrical Wiring Methods. Students will also be introduced to motor controls, PLCs, raceway calculations, voice data video (VDV) structured cabling, as well as retrofitting and/or upgrading existing electrical installations.

9062 Applied Electrical Trades Technology 40S/40E/40M

Students will synthesize and apply knowledge and skills acquired in all previous courses to design, install, troubleshoot, and document electrical circuits with a minimum of supervision and direction. Students will also focus on skills and activities to ease in the transition to employment or post-secondary education.

Guide to Reading Electrical Trades Technology Goals and Learning Outcomes



GRADES 9 TO 11 ELECTRICAL TRADES TECHNOLOGY

General and Specific Learning Outcomes by Goal

Grades 9 to 11 Electrical Trades Technology: General and Specific Learning Outcomes by Goal

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 1: Describe and apply **health and safety** practices.				
GLO 1.1: Describe and apply **health and safety** practices.				
9.1.1.1 Identify safety and health requirements. (A2.1)	10.1.1.1 →	—	11B.1.1.1 →	11C.1.1.1 →
9.1.1.2 Describe the importance of using personal protective equipment (PPE), and identify PPE and procedures related to PPE. (A2.2) (TSA 16)	10.1.1.2 →		11B.1.1.2 Describe the importance of using personal protective equipment (PPE), and identify PPE and procedures related to PPE. (A2.2) (TSA 16)	11C.1.1.2 →
9.1.1.3 Outline the safety principles for working on and around electrical equipment. (A2.3) (TSA 18)	10.1.1.3 →		11B.1.1.3 Outline the safety principles for working on and around electrical equipment. (A2.3) (TSA 18)	11C.1.1.3 →
9.1.1.4 Identify fire safety and outline workplace fire safety principles. (A2.4) (TSA 19)	10.1.1.4 →		11B.1.1.4 Identify fire safety and outline workplace fire safety principles. (A2.4) (TSA 19)	11C.1.1.4 →

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 1: Describe and apply **health and safety** practices. *(continued)* **GLO 1.1:** Describe and apply **health and safety** practices. *(continued)*				
9.1.1.5 Recognize and control hazards. (A2.6)	10.1.1.5 →		11B.1.1.5 Recognize and control hazards. (A2.6)	11C.1.1.5 →
9.1.1.6 Identify the hazards in confined spaces and the preparation needed to work in a confined space. (A2.7) (TSA 20)	10.1.1.6 →		11B.1.1.6 Identify the hazards in confined spaces and the preparation needed to work in a confined space. (A2.7) (TSA 20)	11C.1.1.6 →
9.1.1.7 Identify first aid/ CPR. (A2.8)	10.1.1.7 →		11B.1.1.7 Identify first aid/CPR. (A2.8)	11C.1.1.7 →
9.1.1.8 Explain the Workplace Hazardous Material Information System (WHMIS), and identify the safety requirements as they apply to WHMIS. (A2.9) (TSA 13)	10.1.1.8 →		11B.1.1.8 Explain the Workplace Hazardous Material Information System (WHMIS), and identify the safety requirements as they apply to WHMIS. (A2.9) (TSA 13)	11C.1.1.8 →
9.1.1.9 Identify and control hazards (A2.10)	10.1.1.9 →		11B.1.1.9 Identify and control hazards. (A2.10)	11C.1.1.9 →
9.1.1.10 Create and maintain a safe and organized working environment.	10.1.1.10 →		11B.1.1.10 Create and maintain a safe and organized working environment.	11C.1.1.10 →

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 1: Describe and apply **health and safety** practices. *(continued)* **GLO 1.2:** Demonstrate awareness of electrical safety as it pertains to the ***Trade Safety Awareness Manual***.				
—	10.1.2.1 Explain the importance of trade safety and health in reducing injuries and fatalities to young employees in Manitoba. (TSA 1) 10.1.2.2 Describe the rights and responsibilities of employees, employers, and supervisors under the *Workplace Safety and Health Act*. (TSA 2) 10.1.2.3 Describe the steps to use in the Right to Refuse process. (TSA 3) 10.1.2.4 Explain how and where to find information on workplace safety and health. (TSA 4)	—	—	—

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M

Goal 1: Describe and apply **health and safety** practices. *(continued)*

GLO 1.2: Demonstrate awareness of electrical safety as it pertains to the ***Trade Safety Awareness Manual***. *(continued)*

	10.1.2.5 Demonstrate how to handle a potentially dangerous work situation. (TSA 5) 10.1.2.6 Explain the S.A.F.E. acronym. (TSA 6) 10.1.2.7 Define workplace safety and health hazards. (TSA 7) 10.1.2.8 Give examples of trade-specific workplace safety and health hazards. (TSA 8) 10.1.2.9 Give examples of five types of safety and health hazards. (TSA 9) 10.1.2.10 Define workplace safety and health risk. (TSA 10) 10.1.2.11 Give examples of trade-specific workplace safety and health risks. (TSA 11)			

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M

Goal 1: Describe and apply **health and safety** practices. *(continued)*

GLO 1.2: Demonstrate awareness of electrical safety as it pertains to the ***Trade Safety Awareness Manual***. *(continued)*

	10.1.2.12 Explain the principles of hazard recognition and control as they apply to the electrical trades. (TSA 12) 10.1.2.13 Match the WHMIS hazardous materials symbols and their meanings. (TSA 14) 10.1.2.14 Describe the importance of the Material Safety Data Sheets (MSDS). (TSA 15) 10.1.2.15 Demonstrate proper selection and use of a variety of personal protective equipment and fall protection systems. (TSA 17)			

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 2: Demonstrate the safe and appropriate **identification, selection, operation, maintenance, and management of equipment and tools**. **GLO 2.1:** Demonstrate the safe and appropriate **identification, selection, operation, maintenance, and management of equipment and tools**.				
9.2.1.1 Demonstrate the safe and appropriate identification, selection, and operation of equipment and tools.	10.2.1.1 →	11A.2.1.1 →	11B.2.1.1 →	11C.2.1.1 →
9.2.1.2 Demonstrate the safe and appropriate maintenance and management of equipment and tools.	10.2.1.2 →	11A.2.1.2 →	11B.2.1.2 →	11C.2.1.2 →
9.2.1.3 Demonstrate awareness of DC instruments.	10.2.1.3 Describe DC instruments (including the operation of direct current measuring instruments, as well as their construction and use). (A8.3)	11A.2.1.3 Demonstrate the use of measuring instruments to analyze electrical flow through or within specific electrical circuits. (A8.4)		

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 3: Demonstrate the safe and appropriate **identification, selection, installation, maintenance, and management of devices and materials**. **GLO 3.1:** Demonstrate the safe and appropriate **identification, selection, installation, maintenance, and management of devices and materials**.				
9.3.1.1 Correctly identify devices and materials.	10.3.1.1 →	11A.3.1.1 Correctly identify devices and materials used in DC fundamentals.	11B.3.1.1 Correctly identify devices and materials used in residential wiring.	11C.3.1.1 →
9.3.1.2 Maintain and manage devices and materials.	10.3.1.2 →	11A.3.1.2 →	11B.3.1.2 →	11C.3.1.2 →
9.3.1.3 Interpret information (including colour) found on cables and conductors.	10.3.1.3 →	11A.3.1.3 Select and install DC devices and materials according to industry standards.	11B.3.1.3 Select and install residential wiring devices and materials according to the Canadian Electrical Code (CEC).	11C.3.1.3 →
	10.3.1.4 Select and install devices and materials according to the Canadian Electrical Code (CEC).			

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 4: Demonstrate an understanding of **electrical theory (fundamentals)**. **GLO 4.1:** Demonstrate an understanding of **electrical theory**.				
9.4.1.1 Demonstrate awareness of Ohm's law.	10.4.1.1 Define terminology and describe basic concepts associated with electrical theory and circuitry. (A7.1)	11A.4.1.1 Describe laws of magnetism. (A7.3)	—	—
9.4.1.2 Demonstrate awareness of the theory behind and the differences between series and parallel circuits.	10.4.1.2 Describe battery theory, installation, and maintenance. (A7.2)	11A.4.1.2 Describe and demonstrate electromagnetic induction principles and applications. (A8.2)		
	10.4.1.3 Describe AC wave forms. (A7.4)			
	10.4.1.4 Describe and apply principles and laws that govern electrical circuits. (A8.1)			

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 5: Demonstrate an understanding of the **design, layout, and interpretation of branch circuits and systems**.				
GLO 5.1: Demonstrate an understanding of the **design, layout, and interpretation of branch circuits and systems**.				
—	10.5.1.1 Read, interpret, and draw basic schematic symbols.	—	11B.5.1.1 Read, interpret, and communicate information from a schematic diagram used in residential wiring.	11C.5.1.1 Read, interpret, and communicate information from a schematic diagram used in alternative wiring methods.
	10.5.1.2 Select materials and devices based on the information found on simple wiring diagrams.		11B.5.1.2 Design and draw basic residential branch circuits and systems.	11C.5.1.2 Design and draw branch circuits and systems that utilize alternative wiring methods.
			11B.5.1.3 Create a wiring diagram from a schematic.	11C.5.1.3 →
			11B.5.1.4 Select materials and devices based on the information found on the wiring diagrams.	11C.5.1.4 →

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 6: Demonstrate the procedures used to **install and terminate branch circuits and systems**. **GLO 6.1:** Demonstrate the procedures used to **install and terminate branch circuits and systems**.				
9.6.1.1 Construct circuits.	—	—	11B.6.1.1 Install and terminate residential branch circuits, including materials and devices.	11C.6.1.1 Demonstrate the ability to work with common industrial wiring types (e.g., AC 90, Teck, EMT pipe).
			11B.6.1.2 Perform installation of residential wiring devices. (A6.1)	11C.6.1.2 Terminate branch circuits using other common industrial wiring types (e.g., AC 90, Teck, EMT pipe).
			11B.6.1.3 Interpret and demonstrate use of blueprints for residential applications. (A6.3)	11C.6.1.3 Describe and perform installation of voice data video (VDV) structured fibre optic cabling systems, and community antenna television (CATV) systems. (A6.2)

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 7: Demonstrate an understanding of the **testing, troubleshooting, and documentation of branch circuits and systems**.				
GLO 7.1: Demonstrate an understanding of the **testing, troubleshooting, and documentation of branch circuits and systems**.				
9.7.1.1 Troubleshoot circuits.	10.7.1.1 Demonstrate an understanding of the importance of testing, troubleshooting, and documentation of branch circuits and systems.	11A.7.1.1 Test, troubleshoot, and document DC circuits.	11B.7.1.1 Test, troubleshoot, and document residential branch circuits.	11C.7.1.1 Test, troubleshoot, and document alternative wiring methods.
Goal 8: Describe and demonstrate the transferable **cross-curricular** knowledge and skills.				
GLO 8.1: **Read, interpret, and communicate** information.				
No applicable specific learning outcomes.				
GLO 8.2: Apply the knowledge and skills from **mathematics**.				
—	10.8.2.1 Describe and solve problems using algebraic equations and formulas. (A4.1) 10.8.2.2 Describe and solve the rules of significant figures. (A4.2)	—	11B.8.2.1 Demonstrate proficiency with fractions, decimals, ratios, and percentages. 11B.8.2.2 Demonstrate proficiency in converting from imperial to metric systems of measurement.	—

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 8: Describe and demonstrate the transferable **cross-curricular** knowledge and skills. *(continued)*				
GLO 8.2: Apply the knowledge and skills from **mathematics**. *(continued)*				
	10.8.2.3 Describe and solve basic Ohm's law circuits (series, parallel, and combination). (A4.3)			
GLO 8.3: Apply the knowledge and skills from the **sciences**.				
9.8.3.1 Describe fundamental terms such as current, voltage, resistance, and power.	10.8.3.1 Describe simple machines, force, and pressure related to electrical trade applications. (A4.6) 10.8.3.2 Describe Charles' law and Boyle's law. (A4.7)	—	—	—
GLO 8.4: Apply the knowledge and skills from **information and communication technology**.				
—	—	—	11B.8.4.1 Demonstrate awareness of apps or software used in the electrical trades.	11C.8.4.1 →

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 9: Understand **career opportunities and working conditions**.				
GLO 9.1: Describe **apprenticeship, education, career opportunities, professional organizations, and working conditions** related to electrical trades technology and associated fields.				
—	10.9.1.1 Demonstrate an awareness of apprenticeship. 10.9.1.2 Demonstrate an understanding of various electrical trades and associated occupations.	11A.9.1.1 Demonstrate an understanding of career opportunities in electronics technology.	11B.9.1.1 Demonstrate an awareness of the apprenticeship process in the electrical trades. 11B.9.1.2 Demonstrate an awareness of the working conditions found in the various electrical trades.	—
Goal 10: Demonstrate awareness of **sustainability**.				
GLO 10.1: Describe the impact of **human sustainability** on the health and well-being of tradespersons working in the electrical trades and those who use their services.				
—	10.10.1.1 Demonstrate an awareness of the advantages of electricity and the contributions of electrical tradespersons to human well-being.	11A.10.1.1 Demonstrate an awareness of the widespread use of electricity/electronics in contemporary life.	—	—

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 10: Demonstrate awareness of **sustainability**. *(continued)*				
	GLO 10.2: Describe the electrical trade's **sustainability practices and impact on the environment**.			
9.10.2.1 Minimize wastage of materials.	10.10.2.1 →	11A.10.2.1 →	11B.10.2.1 →	11C.10.2.1 →
	10.10.2.2 Practise reducing, reusing, and recycling materials.		11B.10.2.2 Demonstrate an awareness of the effects of energy-saving electrical devices installed in residences.	11C.10.2.2 Demonstrate an awareness of the effects of energy-saving electrical devices installed in alternative wiring methods.
			11B.10.2.3 Practise reducing, reusing, and recycling materials.	11C.10.2.3 Demonstrate an awareness of the advantages (in terms of sustainability) of using raceways over cable.
	GLO 10.3: Describe **sustainable business practices** within the electrical trades.			
—	10.10.3.1 Demonstrate an understanding of the importance of reducing, reusing, and recycling materials.	—	11B.10.3.1 Design branch circuits using a minimum of materials while meeting code requirements.	11C.10.3.1 Design circuits with alternative wiring using a minimum of materials while meeting code requirements.

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 11: Demonstrate awareness of **ethical and legal standards** as they pertain to the electrical trades. **GLO 11.1:** Demonstrate awareness of **ethical and legal standards**.				
—	10.11.1.1 Demonstrate awareness of ethical standards. 10.11.1.2 Demonstrate respect for school property, including tools, materials, and equipment. 10.11.1.3 Demonstrate an understanding of the legal requirements related to the electrical trades.	11A.11.1.1 Demonstrate an understanding of the requirements for ethical behaviour in school and the workplace.	11B.11.1.1 Demonstrate respect for property that belongs to others (e.g., residences, tools, materials, equipment).	—

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 11: Demonstrate an awareness of **ethical and legal standards** as they pertain to the electrical trades. *(continued)* **GLO 11.2:** Demonstrate an understanding of **electrical codes**.				
—	10.11.2.1 Demonstrate an awareness of code standards in construction. 10.11.2.2 Describe the objectives and scope of the Canadian Electrical Code (CEC). (A5.1) 10.11.2.2 Describe residential system voltages and circuitry. (A5.2)	—	11B.11.2.1 Describe residential wiring methods and practices. (A5.3) 11B.11.2.2 Describe residential wiring devices and applications. (A5.4) 11B.11.2.3 Describe residential device layout and placement. (A5.5) 11B.11.2.4 Describe residential overcurrent protection. (A5.6) 11B.11.2.5 Describe residential loads and related CEC branch circuit calculations. (A5.7)	11C.11.2.1 Demonstrate an understanding of the CEC as it relates to electrical wiring methods.

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 12: Demonstrate **employability skills**. **GLO 12.1:** Demonstrate fundamental **employability skills**.				
9.12.1.1 Demonstrate regular and punctual attendance.	10.12.1.1 →	11A.12.1.1 →	11B.12.1.1 →	11C.12.1.1 →
9.12.1.2 Demonstrate the ability to communicate respectfully and effectively with teachers, supervisors, co-workers, and students.	10.12.1.2 →	11A.12.1.2 →	11B.12.1.2 →	11C.12.1.2 →
9.12.1.3 Demonstrate accountability by taking responsibility for their actions.	10.12.1.3 →	11A.12.1.3 →	11B.12.1.3 →	11C.12.1.3 →
9.12.1.4 Demonstrate adaptability, initiative, and effort.	10.12.1.4 →	11A.12.1.4 →	11B.12.1.4 →	11C.12.1.4 →
9.12.1.5 Demonstrate teamwork skills.	10.12.1.5 →	11A.12.1.5 →	11B.12.1.5 →	11C.12.1.5 →

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 12: Demonstrate **employability skills**. *(continued)*				
GLO 12.1: Demonstrate fundamental **employability skills**. *(continued)*				
9.12.1.6 Demonstrate the ability to stay on task and effectively use time in class and work environments.	10.12.1.6 →	11A.12.1.6 →	11B.12.1.6 →	11C.12.1.6 →
9.12.1.7 Demonstrate the responsible use of wireless communication devices.	10.12.1.7 →	11A.12.1.7 →	11B.12.1.7 →	11C.12.1.7 →
GLO 12.2: Demonstrate an awareness of **cultural competence** and its importance in the workplace.				
—	10.12.2.1 Demonstrate an awareness of culture.	11A.12.2.1 Demonstrate an awareness of how people's culture affects their values and behaviour.	11B.12.2.1 Demonstrate an awareness of the diversity of cultures in society. 11B.12.2.2 Demonstrate an awareness of the importance of respecting the various cultures that would be encountered in potential worksites.	—

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 12: Demonstrate **employability skills**. *(continued)*				
GLO 12.3: Demonstrate an understanding of the **business operation** of an electrical trades facility.				
9.12.3.1 Participate in classroom and workstation cleanup.	10.12.3.1 →	11A.12.3.1 →	11B.12.3.1 →	11C.12.3.1 →
			11B.12.3.2 Demonstrate an awareness of material takeoff lists.	11C.12.3.2 Demonstrate an awareness of inventory control.
			11B.12.3.3 Demonstrate an awareness of the need for sourcing and pricing materials.	
GLO 12.4: Demonstrate **critical thinking skills** in planning, procedures, analysis, and diagnosis.				
9.12.4.1 Demonstrate an awareness of the need for critical thinking and problem solving.	10.12.4.1 Demonstrate an awareness of the need for critical thinking and problem solving while working in the electrical trades.	11A.12.4.1 Demonstrate critical-thinking skills while troubleshooting an electronic project.	11B.12.4.1 Demonstrate critical-thinking skills while troubleshooting branch circuits.	11C.12.4.1 Demonstrate critical-thinking skills while troubleshooting alternative wiring methods.

9054 **Exploration of Electrical Trades Technology (9)** 15S / 15E / 15M 10S / 10E / 10M	9055 **Introduction to Electrical Trades Technology (10)** 20S / 20E / 20M	9056 **Electrical Trades DC Fundamentals (11A)** 30S / 30E / 30M	9057 **Residential Wiring (11B)** 30S / 30E / 30M	9058 **Electrical Wiring Methods (11C)** 30S / 30E / 30M
Goal 13: Understand the **evolution, technological progression, and emerging trends** in the electrical trades. **GLO 13.1:** Understand the **evolution, technological progression, and emerging trends** in the electrical trades.				
—	10.13.1.1 Demonstrate an understanding of the history, technological progression, and emerging trends in the electrical trades.	11A.13.1.1 Demonstrate an understanding of the history, technological progression, and emerging trends in DC fundamentals.	11B.13.1.1 Demonstrate an understanding of the history, technological progression, and emerging trends in residential wiring.	11C.13.1.1 Demonstrate an understanding of the history, technological progression, and emerging trends in electrical wiring methods.

GRADE 12 ELECTRICAL TRADES TECHNOLOGY

General and Specific Learning Outcomes by Goal

Grade 12 Electrical Trades Technology: General and Specific Learning Outcomes by Goal

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 1: Describe and apply **health and safety** practices. **GLO 1.1:** Describe and apply **health and safety** practices.			
12A.1.1.1 Identify safety and health requirements. (A2.1)	12B.1.1.1 →	12C.1.1.1 →	12D.1.1.1 →
12A.1.1.2 Describe the importance of using personal protective equipment (PPE), and identify PPE and procedures related to PPE. (A2.2) (TSA 16)	12B.1.1.2 →	12C.1.1.2 →	12D.1.1.2 →
12A.1.1.3 Outline the safety principles for working on and around electrical equipment. (A2.3) (TSA 18)	12B.1.1.3 →	12C.1.1.3 →	12D.1.1.3 →
12A.1.1.4 Identify fire safety and outline workplace fire safety principles. (A2.4) (TSA 19)	12B.1.1.4 →	12C.1.1.4 →	12D.1.1.4 →
12A.1.1.5 Recognize and control hazards. (A2.6)	12B.1.1.5 →	12C.1.1.5 →	12D.1.1.5 →

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 1: Describe and apply **health and safety** practices. *(continued)* **GLO 1.1:** Describe and apply **health and safety** practices. *(continued)*			
12A.1.1.6 Identify the hazards in confined spaces and the preparation needed to work in a confined space. (A2.7) (TSA 20)	12B.1.1.6 →	12C.1.1.6 →	12D.1.1.6 →
12A.1.1.7 Identify first aid/ CPR. (A2.8)	12B.1.1.7 →	12C.1.1.7 →	12D.1.1.7 →
12A.1.1.8 Explain the Workplace Hazardous Material Information System (WHMIS), and identify the safety requirements as they apply to WHMIS. (A2.9) (TSA 13)	12B.1.1.8 →	12C.1.1.8 →	12D.1.1.8 →
12A.1.1.9 Identify and control hazards. (A2.10)	12B.1.1.9 →	12C.1.1.9 →	12D.1.1.9 →
12A.1.1.10 Create and maintain a safe and organized working environment.	12B.1.1.10 →	12C.1.1.10 →	12D.1.1.10 →

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 1: Describe and apply **health and safety** practices. *(continued)* **GLO 1.2:** Demonstrate awareness of electrical safety as it pertains to the ***Trade Safety Awareness Manual***.			
—	—	12C.1.2.1 Explain the importance of trade safety and health in reducing injuries and fatalities to young employees in Manitoba. (TSA 1) 12C.1.2.2 Describe the rights and responsibilities of employees, employers, and supervisors under the *Workplace Safety and Health Act*. (TSA 2) 12C.1.2.3 Describe the steps to use in the Right to Refuse process. (TSA 3) 12C.1.2.4 Explain how and where to find information on workplace safety and health. (TSA 4) 12C.1.2.5 Demonstrate how to handle a potentially dangerous work situation. (TSA 5)	—

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 1: Describe and apply **health and safety** practices. *(continued)* **GLO 1.2:** Demonstrate awareness of electrical safety as it pertains to the ***Trade Safety Awareness Manual***. *(continued)*			
		12C.1.2.6 Explain the S.A.F.E. acronym. (TSA 6) 12C.1.2.7 Define workplace safety and health hazards. (TSA 7) 12C.1.2.8 Give examples of trade-specific workplace safety and health hazards. (TSA 8) 12C.1.2.9 Give examples of five types of safety and health hazards. (TSA 9) 12C.1.2.10 Define workplace safety and health risk. (TSA 10) 12C.1.2.11 Give examples of trade-specific workplace safety and health risks. (TSA 11)	

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 1: Describe and apply **health and safety** practices. *(continued)* **GLO 1.2:** Demonstrate awareness of electrical safety as it pertains to the ***Trade Safety Awareness Manual***. *(continued)*			
		12C.1.2.12 Explain the principles of hazard recognition and control as they apply to the electrical trades. (TSA 12) 12C.1.2.13 Match the WHMIS hazardous materials symbols and their meanings. (TSA 14) 12C.1.2.14 Describe the importance of the Material Safety Data Sheets (MSDS). (TSA 15) 12C.1.2.15 Demonstrate proper selection and use of a variety of personal protective equipment and fall protection systems. (TSA 17)	

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 2: Demonstrate the safe and appropriate **identification, selection, operation, maintenance, and management of equipment and tools**.			
GLO 2.1: Demonstrate the safe and appropriate **identification, selection, operation, maintenance, and management of equipment and tools**.			
12A.2.1.1 Demonstrate the safe and appropriate identification, selection, and operation of equipment and tools (e.g., mega ohmmeter).	12B.2.1.1 →	12C.2.1.1 Demonstrate the safe and appropriate identification, selection, and operation of equipment and tools associated with motor controls.	12D.2.1.1 →
		12C.2.1.2 Demonstrate the safe and appropriate identification, selection, and operation of equipment and tools associated with various types of raceways.	12D.2.1.2 →
		12C.2.1.3 Demonstrate the safe and appropriate identification, selection, and operation of equipment and tools associated with retrofitting or upgrading existing electrical installations.	12D.2.1.3 →

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 3: Demonstrate the safe and appropriate **identification, selection, installation, maintenance, and management of devices and materials**. **GLO 3.1:** Demonstrate the safe and appropriate **identification, selection, installation, maintenance, and management of devices and materials**.			
12A.3.1.1 Demonstrate the safe and appropriate identification, selection, installation, maintenance, and management of devices and materials used in service installations.	—	12C.3.1.1 Demonstrate the safe and appropriate identification, selection, installation, maintenance, and management of motor controls.	12D.3.1.1 →
		12C.3.1.2 Demonstrate the safe and appropriate identification, selection, installation, maintenance, and management of raceways-associated boxes and devices.	12D.3.1.2 →
		12C.3.1.3 Demonstrate the safe and appropriate identification, selection, installation, maintenance, and management of retrofitting or upgrading existing electrical installations.	12D.3.1.3 →

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 4: Demonstrate an understanding of **electrical theory**. **GLO 4.1:** Demonstrate an understanding of **electrical theory**.			
12A.4.1.1 Demonstrate an understanding of home automation technologies (e.g., programmable thermostats, remote control lighting, security systems, etc.).	12B.4.1.1 Describe the nature of magnetic fields, including the concept of flux, force fields, and the field around current-carrying conductors.	12C.4.1.1 Demonstrate an understanding of the theory associated with motor controls and PLCs.	12D.4.1.1 Synthesize theoretical knowledge required to design, lay out, and interpret electrical branch circuits and systems.
	12B.4.1.2 Describe how magnetic flux, flux density, magnetomotive force, and reluctance are related.	12C.4.1.2 Demonstrate an understanding of the theory associated with raceways-associated boxes and devices.	
	12B.4.1.3 Calculate the current required to establish a required magnetic flux in a series magnetic circuit.	12C.4.1.3 Demonstrate an understanding of the theory associated with retrofitting or upgrading existing electrical installations.	
	12B.4.1.4 Demonstrate the operation of a relay as a magnetic circuit.		
	12B.4.1.5 Demonstrate how forces are created by magnetic attraction in relays and solenoids (e.g., ampere turns).		

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 4: Demonstrate an understanding of **electrical theory**. *(continued)* **GLO 4.1:** Demonstrate an understanding of **electrical theory**. *(continued)*			
	12B.4.1.6 Describe electromagnetism and inductance, including the operation of coils (i.e., rotating magnetic fields, generator applications, stored energy [Lenz's Law], and motor principles). 12B.4.1.7 Explain the difference between DC and AC. 12B.4.1.8 Explain why in some industrial applications DC is preferred to AC. 12B.4.1.9 Describe the advantages that AC has over DC in the generation, transmission, and distribution systems, and explain why it has these advantages. 12B.4.1.10 Explain why high voltage DC has been used for transmission of energy from distant generating stations.		

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 4: Demonstrate an understanding of **electrical theory**. *(continued)* **GLO 4.1:** Demonstrate an understanding of **electrical theory**. *(continued)*			
	12B.4.1.11 Demonstrate the graphic method of generating sine waves and cosine waves, and relate these waves to the trigonometric formula. 12B.4.1.12 Demonstrate how a sinusoidal voltage is generated when a coil is rotated in a uniform magnetic field. 12B.4.1.13 Describe which factors determine the frequency of the voltage from an AC generator. 12B.4.1.14 Define instantaneous, peak, and RMS values. 12B.4.1.15 Describe the phase relationship between voltage and current in an AC circuit containing a resistance.		

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 4: Demonstrate an understanding of **electrical theory**. *(continued)* **GLO 4.1:** Demonstrate an understanding of **electrical theory**. *(continued)*			
	12B.4.1.16 Describe the effective values of AC current and voltages. 12B.4.1.17 Calculate the power dissipated in a resistor for a given applied peak voltage. 12B.4.1.18 Explain the difference between the voltage given by an AC voltmeter and that displayed on an oscilloscope. 12B.4.1.19 Describe a power curve, the current, and voltage in phase. 12B.4.1.20 Describe the action of a half and full wave rectifier, and explain why average values instead of effective values are used for computing the DC output.		

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 5: Demonstrate an understanding of the **design, layout, and interpretation of branch circuits and systems**.			
GLO 5.1: Demonstrate an understanding of the **design, layout, and interpretation of branch circuits and systems**.			
12A.5.1.1 Design and interpret home automation technologies (e.g., programmable thermostats, remote control lighting, security systems, etc.).	—	12C.5.1.1 Design, lay out, and/or interpret motor controls.	12D.5.1.1 Synthesize knowledge and skills required to design, lay out, and interpret branch circuits and systems with minimal supervision and direction.
12A.5.1.2 Select components based on service calculations for single phase 3 wire, 120/240V.		12C.5.1.2 Incorporate raceways-associated boxes and devices into an electrical installation. 12C.5.1.3 Design, lay out, and/or interpret a retrofit or upgrade to existing electrical installations.	

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 6: Demonstrate the procedures used to **install and terminate branch circuits and systems**.			
GLO 6.1: Demonstrate the procedures used to **install and terminate branch circuits and systems**.			
12A.6.1.1 Install and terminate basic home automation technologies (e.g., programmable thermostats, remote control lighting, security systems, etc.).	—	12C.6.1.1 Install and terminate motor controls.	12D.6.1.1 Synthesize knowledge and skills required to install and terminate branch circuits and systems with minimal supervision and direction.
12A.6.1.2 Install and terminate residential systems.		12C.6.1.2 Install and terminate electrical installations incorporating raceways-associated boxes and devices.	
12A.6.1.3 Ensure the aesthetic appearance of electrical installations (e.g., using drop sheets, patching holes, etc.).		12C.6.1.3 Retrofit or upgrade existing electrical installations.	
12A.6.1.4 Describe and demonstrate various mounting methods for residential applications. (A6.4)			

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 7: Demonstrate an understanding of the **testing, troubleshooting, and documentation of branch circuits and systems**. **GLO 7.1:** Demonstrate an understanding of the **testing, troubleshooting, and documentation of branch circuits and systems**.			
12A.7.1.1 Test, troubleshoot, and document home automation technologies (e.g., programmable thermostats, remote control lighting, security systems, etc.).	—	12C.7.1.1 Test, troubleshoot, and document motor controls. 12C.7.1.2 Test, troubleshoot, and document electrical installations incorporating raceways-associated boxes and devices. 12C.7.1.3 Test, troubleshoot, and document retrofits or upgrades to existing electrical installations.	12D.7.1.1 Synthesize knowledge and skills required to design, lay out, and interpret branch circuits and systems with minimal supervision and direction.

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 8: Describe and demonstrate the transferable **cross-curricular** knowledge and skills. **GLO 8.1: Read, interpret, and communicate** information.			
12A.8.1.1 Read, interpret, and communicate information from unfamiliar schematic diagrams.	—	—	12D.8.1.1 Demonstrate the ability to navigate unfamiliar portions of the Canadian Electrical Code (CEC) in order to find applicable and relevant information and regulations. 12D.8.1.2 Describe the communication skills/modes used in the workplace. (A3.1) 12D.8.1.3 Describe the importance of the customer. (A3.2) 12D.8.1.4 Describe effective techniques for addressing customer complaints. (A3.3) 12D.8.1.5 Describe techniques for maintaining good communication in the workplace. (A3.4) 12D.8.1.6 Describe general organization and basic reading strategies for trade-related documents. (A3.5)

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 8: Describe and demonstrate the transferable **cross-curricular** knowledge and skills. *(continued)* **GLO 8.2:** Apply knowledge and skills from **mathematics**.			
12A.8.2.1 Calculate demand load for residential service requirements. 12B.8.2.2 Correctly manipulate the scales found on blueprints. 12C.8.2.3 Describe and demonstrate how to plot data on graphs. (A4.4)	12B.8.2.1 Describe and solve right-angle triangles with the use of electrical terminology. (A4.5)	12C.8.2.1 Demonstrate the mathematical skills required to bend, cut, and fabricate conduit.	12D.8.2.1 Demonstrate the mathematical skills required to install and terminate branch circuits and systems.

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 8: Describe and demonstrate the transferable **cross-curricular** knowledge and skills. *(continued)*			
GLO 8.3: Apply knowledge and skills from the **sciences**.			
—	—	—	12D.8.3.1 Demonstrate the knowledge and skills from science required to install and terminate branch circuits and systems.
GLO 8.4: Apply the knowledge and skills from **information and communication technology**.			
—	—	—	12D.8.4.1 Create trade-related documents using proper writing techniques. (A3.6) 12D.8.4.2 Demonstrate trade-related computer skills, as specified by the instructor. (A3.7)

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 9: Understand **career opportunities and working conditions**.			
GLO 9.1: Describe **apprenticeship, education, career opportunities, professional organizations, and working conditions** related to electrical trades technology and associated fields.			
12A.9.1.1 Demonstrate an awareness of the variety of working conditions (i.e., weather conditions, sanitation facilities, isolated locations, hours) found in the electrical trades, including residential, commercial, industrial, power electrician, etc.	—	12C.9.1.1 Demonstrate an awareness of the professional organizations related to electrical trades technology and associated fields.	12D.9.1.1 Describe the structure and scope of the construction electrician, industrial electrician, and power electrician trades. (A1.1)
		12C.9.1.2 Demonstrate an awareness of the process for becoming a Red Seal journeyperson electrician.	12D.9.1.2 Describe two levels of workplace competency. (A1.2)
			12D.9.1.3 Describe accommodation for apprentices with disabilities. (A1.3)
			12D.9.1.4 Create a portfolio for obtaining employment.
			12D.9.1.5 Research potential employers in the electrical trades and associated fields.

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 10: Demonstrate awareness of **sustainability**.			
GLO 10.1: Describe the impact of **human sustainability** on the health and well-being of tradespersons working in the electrical trades and those who use their services.			
12A.10.1.1 Demonstrate an awareness of the long-term health concerns associated with the electrical trades. 12A.10.1.2 Identify ergonomics. (A2.5)	12B.10.1.1 Demonstrate an awareness of possible health concerns related to high tension power lines.	12C.10.1.1 Demonstrate an awareness of the contributions of electricity to contemporary life.	—
GLO 10.2: Describe the electrical trade's **sustainability practices and impact on the environment**.			
12A.10.2.1 Minimize wastage of materials.	12B.10.2.1 →	12C.10.2.1 →	12D.10.2.1 →
12A.10.2.2 Demonstrate an awareness of the recycling of used copper and aluminium.	12B.10.2.2 Demonstrate an understanding of how electricity is generated, focusing on Manitoba.	12C.10.2.2 Participate in a material recycling program.	12D.10.2.2 Design circuits and systems that maximize the efficient use of materials.
GLO 10.3: Describe **sustainable business practices** within the electrical trades.			
12A.10.3.1 Demonstrate an understanding of the importance of effective price management.	—	12C.10.3.1 Demonstrate an understanding of the importance of pricing jobs in order to maximize profits.	12D.10.3.1 Demonstrate an understanding of the importance of remaining up to date with current technologies.

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 11: Demonstrate an awareness of **ethical and legal standards** as they pertain to the electrical trades.			
GLO 11.1: Demonstrate an awareness of **ethical and legal standards**.			
12A.11.1.1 Demonstrate ethical behaviour (including respecting the property of others) while working at a workplace.	—	12C.11.1.1 Demonstrate an awareness of the importance of following contract agreements (verbal and written), including quality of work and materials used.	—
12A.11.1.2 Demonstrate the purpose of building permits and their use in the electrical trades.		12C.11.1.2 Demonstrate an awareness of the legal requirements related to the electrical trades, including the installation of non-CSA approved equipment.	
GLO 11.2: Demonstrate understanding of **electrical codes**.			
12A.11.2.1 Demonstrate awareness of building codes that pertain to the electrical trades, but are not found in the CEC.	—	—	—
12A.11.2.2 Describe the installation and maintenance of power distribution and perform service calculations for single phase 3 wire (120/240V). (A5.8)			

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 12: Demonstrate **employability skills**. **GLO 12.1:** Demonstrate fundamental **employability skills**.			
12A.12.1.1 Demonstrate regular and punctual attendance.	12B.12.1.1 →	12C.12.1.1 →	12D.12.1.1 →
12A.12.1.2 Demonstrate the ability to communicate respectfully and effectively with teachers, supervisors, co-workers, and students.	12B.12.1.2 →	12C.12.1.2 →	12D.12.1.2 →
12A.12.1.3 Demonstrate accountability by taking responsibility for their actions.	12B.12.1.3 →	12C.12.1.3 →	12D.12.1.3 →
12A.12.1.4 Demonstrate adaptability, initiative, and effort.	12B.12.1.4 →	12C.12.1.4 →	12D.12.1.4 →
12A.12.1.5 Demonstrate teamwork skills.	12B.12.1.5 →	12C.12.1.5 →	12D.12.1.5 →
12A.12.1.6 Demonstrate the ability to stay on task and effectively use time in class and work environments.	12B.12.1.6 →	12C.12.1.6 →	12D.12.1.6 →
12A.12.1.7 Demonstrate the responsible use of wireless communication devices.	12B.12.1.7 →	12C.12.1.7 →	12D.12.1.7 →

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 12: Demonstrate **employability skills**. *(continued)*			
GLO 12.2: Demonstrate an awareness of **cultural competence** and its importance in the workplace.			
12A.12.2.1 Demonstrate an awareness of the need to interact positively with people of different cultures in society and in the workplace.	—	12C.12.2.1 Demonstrate an awareness of the principles of cultural proficiency.	12D.12.2.1 Demonstrate respect for cultural differences.
GLO 12.3: Demonstrate an understanding of the **business operation** of an electrical trades organization.			
12A.12.3.1 Participate in classroom and workstation cleanup. 12A.12.3.2 Develop material take off lists from information on blueprint or site assessment. 12A.12.3.3 Source and price materials.	12B.12.3.1 →	12C.12.3.1 Estimate time required to complete assigned task. 12C.12.2.2 Demonstrate basic estimating techniques.	12D.12.3.1 →

9059 **Advanced Residential Wiring (12A)** 40S / 40E / 40M	9060 **Electrical Trades AC Fundamentals (12B)** 40S / 40E / 40M	9061 **Advanced Electrical Wiring Methods (12C)** 40S / 40E / 40M	9062 **Applied Electrical Trades Technology (12D)** 40S / 40E / 40M
Goal 12: Demonstrate **employability skills**. *(continued)* **GLO 12.4:** Demonstrate **critical thinking skills** in planning, procedures, analysis, and diagnosis.			
12A.12.4.1 Demonstrate critical-thinking skills.	12B.12.4.1 →	12C.12.4.1 →	12D.12.4.1 Demonstrate critical-thinking skills required to install and terminate branch circuits and systems with a minimum of supervision and direction.
12A.12.4.2 Use a variety of strategies in order to diagnose and solve problems.	12B.12.4.2 →	12C.12.4.2 →	12D.12.4.2 Demonstrate critical-thinking skills required to analyze and diagnose problems with a minimum of supervision and direction.
Goal 13: Understand the **evolution, technological progression, and emerging trends** in the electrical trades. **GLO 13.1:** Understand the **evolution, technological progression, and emerging trends** in the electrical trades.			
12A.13.1.1 Demonstrate an awareness of the evolution, technological progression, and emerging trends in residential wiring.	12B.13.1.1 Demonstrate an awareness of the history behind the adoption of AC over DC as household current.	12C.13.1.1 Demonstrate an awareness of the evolution, technological progression, and emerging trends in alternative wiring methods.	12D.13.1.1 Demonstrate an awareness of the evolution, technological progression, and emerging trends in electrical power generation.

BIBLIOGRAPHY

BIBLIOGRAPHY

Apprenticeship Manitoba. "Construction Electrician." *Manitoba Trades*. n.d. www.manitoba.ca/wd/apprenticeship/discover/mbtrades/constructionelectrician.html (date of access—01 February 2018).

———. "Industrial Electrician." *Manitoba Trades*. n.d. www.gov.mb.ca/wd/apprenticeship/discover/mbtrades/industrialelect.html (date of access—01 February 2018).

———. "Power Electrician." *Manitoba Trades*. n.d. www.manitoba.ca/wd/apprenticeship/discover/mbtrades/powerelectrician.html (date of access—01 February 2018).

———. *Unit to Course Comparison (UCC) Form – Common Core Electrician Level 1*. 2015. www.edu.gov.mb.ca/k12/cur/teched/sytep/electrical/ucc.pdf (date of access—01 February 2018)

CSA Group. C*22.1-12 – Canadian Electrical Code, Part I: Safety Standard for Electrical Installations* (22nd edition). Toronto, ON: CSA Group, 2012.

———. *C22.1HB-12 – CE Code Handbook: An Explanation of Rules of the Canadian Electrical Code, Part 1*. Toronto, ON: CSA Group, 2012.

Gerrish, Howard H., William Dugger, and Richard M. Roberts. *Electricity and Electronics*. Tinley Park, IL: The Goodheart-Willcox Company, Ltd., 2004.

Herman, Stephen L. *Delmar's Standard Textbook of Electricity* (5th edition). Toronto, ON: Cengage Learning—A Division of Nelson Education Ltd., 2011.

———. *Alternating Current Fundamentals* (8th edition). Toronto, ON: Cengage Learning, 2012.

———. *Direct Current Fundamentals* (8th edition). Toronto, ON: Cengage Learning, 2011.

———. *Industrial Motor Control* (7th edition). Toronto, ON: Nelson Education Ltd., 2014.

———. *Practical Problems in Mathematics for Electricians* (9th edition). Toronto, ON: Cengage Learning, 2012.

Kubala, Thomas. *Electricity 1, Devices, Circuits & Materials* (9th edition). Toronto, ON: Cengage Learning, 2008.

Manitoba Apprenticeship and Certification Board. *Instructor Trade Safety Awareness Manual*. Winnipeg, MB: Province of Manitoba, 2013. https://www.gov.mb.ca/wd/apprenticeship/pdfpubs/pubs/general/trade_safety/instructor.pdf (date of access—01 February 2018).

———. *Student Trade Safety Awareness Workbook*. Winnipeg, MB: Province of Manitoba, 2013. https://www.gov.mb.ca/wd/apprenticeship/pdfpubs/pubs/general/trade_safety/apprentice.pdf (date of access—01 February 2018).

Manitoba Education. "Technical Vocational Education Overview". Winnipeg, MB: Manitoba Education, 2013. www.edu.gov.mb.ca/k12/cur/teched/sytep/docs/overview.pdf (date of access—01 February 2018).

Manitoba Education and Training. "Industrial Arts." Technology Education. n.d. www.edu.gov.mb.ca/k12/cur/teched/ind_arts.html (date of access—01 February 2018).

———. "Technical Vocational Teacher." *Professional Certification*. n.d. www.edu.gov.mb.ca/k12/profcert/certificates/vocational.html (date of access—01 February 2018).

———. *Subject Table Handbook: Technology Education: Student Records System and Professional School Personnel System*. Winnipeg, MB: Manitoba Education and Training, n.d. www.edu.gov.mb.ca/k12/docs/policy/sthte/index.html (date of access—01 February 2018).

———. "Senior Years Technology Education Program." *Technology Education*. n.d. www.edu.gov.mb.ca/k12/cur/ teched/sy_tech_program.html (date of access—01 February 2018).

Mullin, Ray, Robert Filice, Sam Maltese, and Dennis Marchetti. *Electrical Wiring: Commercial* (6th Canadian Edition). Toronto, ON: Nelson Education Ltd, 2013.

Mullin, Ray, Tony Branch, and Sandy Gerolimon. *Electrical Wiring: Residential* (6th Canadian Edition). Toronto, ON: Nelson Education Ltd., 2013.

P.S. Knight Co. Ltd. *Electrical Code Simplified: Residential Wiring: Multi-Province Book 1 (Alberta, Saskatchewan, Manitoba, New Brunswick, Nova Scotia, P.E.I., Newfoundland)*. Calgary, AB: P.S. Knight Co. Ltd, 2015.

———. *Electrical Code Simplified: Commercial & Industrial Book 2*. Calgary, AB: P.S. Knight Co. Ltd., 2012.

Red River College. "Technical Vocational Teacher Education." *Program and Course Catalogue*. Winnipeg, MB: Red River College, 2017. http://me.rrc.mb.ca/Catalogue/ProgramInfo.aspx?ProgCode=TECVP-DP&RegionCode=WPG (date of access—01 February 2018).

Red Seal Program. "Construction Electrician." *Red Seal Program*. www.red-seal.ca/trades/c.4nst_.2l.2ctr.3c-eng.html (date of access—01 February 2018).

———. "Industrial Electrician." *Red Seal Program*. www.red-seal.ca/trades/.3nd.5str.3.1l_.2l.2ctr.3c-eng.html (date of access—01 February 2018).

Zbar, Paul B. *Basic Electricity: A Text—Lab Manual* (7th edition). New York, NY: Glencoe McGraw-Hill, 2001.

———. *Instructor's Guide for Basic Electricity: A Text—Lab Manual* (7th edition). New York, NY: Glencoe McGraw-Hill, 2001.

Printed in Canada
Imprimé au Canada