

# **Grades 9 to 12 Electronics Technology**

Manitoba Technical-Vocational  
Curriculum Framework  
of Outcomes





GRADES 9 TO 12  
ELECTRONICS TECHNOLOGY

Manitoba Technical-Vocational Curriculum  
Framework of Outcomes

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Available in alternate formats upon request.

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# TECHNICAL-VOCATIONAL EDUCATION OVERVIEW

In 2013, Manitoba Education released the document *Technical-Vocational Education Overview* to provide the philosophical and pedagogical underpinnings for curriculum development and the teaching of courses in the Senior Years Technology Education Program. This overview presents educators with the vision and goals of technical-vocational education (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

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

# ELECTRONICS TECHNOLOGY OVERVIEW

## Introduction

*Grades 9 to 12 Electronics Technology: Manitoba Technical-Vocational Curriculum Framework of Outcomes* provides students with an introduction to the knowledge and skills associated with the design, installation, and repair of electronic equipment. Students who study electronics technology apply problem-based learning that incorporates science, technology, engineering, and mathematics.

Students will learn to use diagnostic equipment to analyze various electronic components and related circuits. They will also learn basic prototyping skills through the fabrication of circuit boards and projects, and gain valuable soldering skills. Finally, they will also learn to program and interface with microprocessor devices.

## Curriculum Description

To receive a Senior Years Technical Education diploma, a student must complete eight departmentally developed courses from an approved technical-vocational cluster, together with 16 compulsory credits and six optional 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 document.

In the TVE curriculum, the emphasis is on applied learning. For instructional purposes, the sequence of outcomes can vary, based on the learning activities within a course. Teachers are advised to select the learning activities best suited to addressing the learning outcomes, based on a variety of factors, including access to resources and regional needs.

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

## Career and Post-Secondary Opportunities

Students who complete the program can find entry-level positions in a number of industries, such as transportation, communication, and generation of electrical power. These industries may provide further training to the successful applicant.

Students will also be well equipped to successfully pursue post-secondary studies in instrumentation engineering technology, electronics engineering technology, electrical engineering technology, and information and communication technologies. These opportunities can be found in both colleges and universities.

## Electronics Technology Goals and General Learning Outcomes (GLOs)

The specific learning outcomes for each course in the electronics technology program are based on the following program goals and general learning outcomes.

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

**GLO 1.1:** Describe and apply appropriate **health and safety** practices.

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**Goal 2:** Demonstrate the **identification, selection, utilization, and maintenance** of **tools and materials**.

**GLO 2.1:** Demonstrate the **identification** and **selection** of tools and materials.

**GLO 2.2:** Demonstrate the **utilization** of tools and materials.

**GLO 2.3:** Demonstrate the **maintenance** of tools and materials

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**Goal 3:** Demonstrate the **identification, selection, value determination, and utilization** of **components**.

**GLO 3.1:** Demonstrate the **identification** and **selection** of components.

**GLO 3.2:** Demonstrate the **value determination** of components.

**GLO 3.3:** Demonstrate the **utilization** of components.

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**Goal 4:** Demonstrate the **utilization and maintenance** of **equipment**.

**GLO 4.1:** Demonstrate the **utilization and maintenance** of **equipment other than diagnostic equipment**.

**GLO 4.2:** Demonstrate the **utilization and maintenance** of **diagnostic equipment**.

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**Goal 5:** Demonstrate **schematic reading**.

**GLO 5.1:** Read, understand, and interpret **schematic diagrams**.

**GLO 5.2:** Demonstrate **rendering**.

**GLO 5.3:** Demonstrate **breadboarding**.

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**Goal 6:** Demonstrate an understanding of **electrical theory** and the **analysis of electrical circuits**.

**GLO 6.1:** Demonstrate an understanding of **electrical theory**.

**GLO 6.2:** Demonstrate the appropriate procedures for **analyzing electrical circuits**.

---

**Goal 7:** Demonstrate **soldering skills, fabricating printed circuit boards, and selecting and installing components**.

**GLO 7.1:** Demonstrate **soldering skills**.

**GLO 7.2:** Demonstrate the procedures for **selecting and installing components**.

**GLO 7.3:** Demonstrate the procedures for **fabricating printed circuit boards**.

---

**Goal 8:** Describe and demonstrate the transferable **cross-curricular** knowledge and skills as they apply to electronics technology.

**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**.

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**Goal 9:** Understand **education, career opportunities, employment conditions, and professional organizations** in the electronics industry.

**GLO 9.1:** Understand **education, career opportunities, employment conditions, and professional organizations** in the electronics industry.

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**Goal 10:** Demonstrate awareness of **sustainability** as it pertains to electronics technology.

**GLO 10.1:** Describe the impact of **human sustainability** on the health and well-being of electronics technicians, and those who use their products.

**GLO 10.2:** Describe the electronic technology's sustainability practices and impact on the **environment**.

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**Goal 11:** Demonstrate awareness of the **ethical standards and legal issues**.

**GLO 11.1:** Demonstrate awareness of the **ethical standards and legal issues**.

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**Goal 12:** Demonstrate **employability skills**.

**GLO 12.1:** Demonstrate **fundamental employability skills**.

**GLO 12.2:** Demonstrate an awareness of **cultural proficiency** and its importance in the workplace.

**GLO 12.3:** Demonstrate **critical thinking skills** in planning, procedures, analysis, and diagnosis.

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**Goal 13:** Understand the **evolution, technological progression, and emerging trends** in electronics technology.

**GLO 13.1:** Describe the **evolution, technological progression, and emerging trends** in electronics technology.

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## Specific Learning Outcomes (SLOs)

*Grades 9 to 12 Electronics 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 electronics 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 the electronics technology 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 nine electronics technology courses follow. For an explanation of the codes, refer to the [\*Subject Table Handbook: Technology Education: Student Records System and Professional School Personnel System\*](#) (Manitoba Education and Advanced Learning).

9037 Exploration of Electronics  
Technology (Optional) 10S/10E/10M  
15S/15E/15M

This optional course can be taught as a half or full credit. Students will have the opportunity to explore various aspects of the electronics industry that will equip them to make an informed decision about pursuing more courses in this subject area. Students will learn about terminology, basic electrical theory, and electronic test equipment.

9038 Introduction to Electronics  
Technology 20S/20E/20M

Students will be introduced to 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.

9039 Electronics AC Circuit  
Fundamentals 30S/30E/30M

This course builds on the electrical theory learned in Introduction to Electronics Technology. It focuses on AC waveforms and how they interact with reactive components in RL, RC, and RCL series and parallel circuits. They will also explore frequency-sensitive circuits.

9048 Semiconductor Technology  
and Signal Devices 30S/30E/30M

Students will learn about semiconductor materials and device construction, and how they affect current flow. They will also learn about low power signal devices, such as diodes and transistors, and how they are used in simple circuits.

9049 Semiconductor Power Devices 30S/30E/30M

This course builds on the semiconductor theory learned in Semiconductor Technology and Signal Devices. It focuses on power devices, such as thyristors, power transistors, and MOSFETs, as well as their applications.

9050 Digital Devices and  
Basic Logic 40S/40E/40M

This course focuses on the branch of electronics technology dealing with binary states. Students will learn the difference between analog and digital signals as well as the different number systems employed in digital systems. Students will also learn the basic logic gates and how they are combined to solve digital logic problems.

9051 Advanced Digital Systems 40S/40E/40M

This course builds on the skills and theory learned in Digital Devices and Basic Logic. It focuses on higher-level functions such as multiplexers, decoders, counters, displays, etc.

9052 Microprocessors 40S/40E/40M

This course focuses on the branch of digital logic dealing with programmable devices. Students will learn basic programming control structures and how to use microprocessors to perform rudimentary functions.

9053 Microprocessor Applications 40S/40E/40M

This course builds on the skills and theory learned in Microprocessors. It focuses on higher-level functions such as analog to digital and digital to analog conversion, pulse-width modulation, frequency sampling, etc.

## Curriculum Implementation Dates

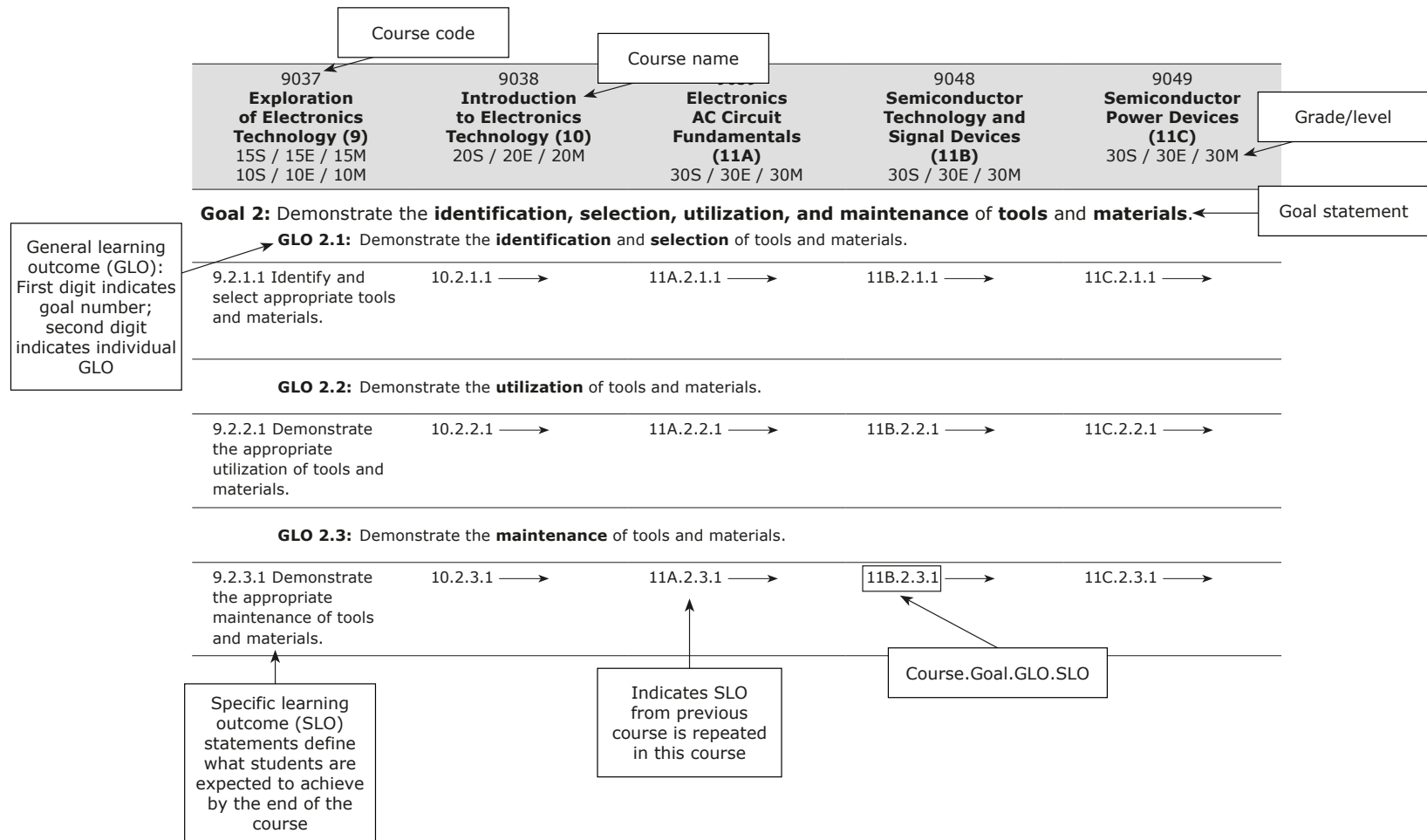
During **voluntary implementation**, teachers have the option of teaching the entire new draft curriculum as soon as Manitoba Education and Advanced Learning releases it on the [Technology Education](#) website. They also have the option of teaching the courses from the previous curriculum. Teachers who implement courses before system-wide implementation need to ensure that students who are already taking courses from the previous curriculum achieve all SLOs with a minimum of redundancy.

Voluntary implementation of all electronics technology courses began in the fall of 2014 and will continue until their respective system-wide implementation dates.

Date	System-Wide Implementation
Fall 2015	Grade 9 (optional)
Fall 2016	Grade 10
Fall 2017	Grade 11
Fall 2018	Grade 12

Under **system-wide implementation**, all teachers in Manitoba teach the new curriculum and use the new course codes. Teachers will no longer be able to use the previous course codes. Course codes are found in the [Subject Table Handbook: Technology Education](#).

# Guide to Reading Electronics Technology Goals and Learning Outcomes









GRADES 9 TO 11  
ELECTRONICS TECHNOLOGY

General and Specific Learning  
Outcomes by Goal



## GRADES 9 TO 11 ELECTRONICS TECHNOLOGY: GENERAL AND SPECIFIC LEARNING OUTCOMES BY GOAL

9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 1:** Describe and apply appropriate **health and safety** practices.

**GLO 1.1:** Describe and apply appropriate **health and safety** practices.

9.1.1.1 Create and maintain a safe work environment.	10.1.1.1 →	11A.1.1.1 →	11B.1.1.1 →	11C.1.1.1 →
9.1.1.2 Describe and utilize personal protective equipment (PPE) and follow prescribed procedures.	10.1.1.2 →	11A.1.1.2 →	11B.1.1.2 →	11C.1.1.2 →
9.1.1.3 Demonstrate an awareness of electrical safety.	10.1.1.3 →	11A.1.1.3 →	11B.1.1.3 →	11C.1.1.3 →
9.1.1.4 Demonstrate an awareness of fire safety.	10.1.1.4 →	11A.1.1.4 →	11B.1.1.4 →	11C.1.1.4 →
9.1.1.5 Recognize and control hazards.	10.1.1.5 →	11A.1.1.5 →	11B.1.1.5 →	11C.1.1.5 →

9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 1:** Describe and apply appropriate **health and safety** practices. *(continued)*

**GLO 1.1:** Describe and apply appropriate **health and safety** practices. *(continued)*

9.1.1.6 Demonstrate an understanding of how Ohm’s law relates to electrical safety.	10.1.1.6 →	11A.1.1.6 →	11B.1.1.6 →	11C.1.1.6 →
9.1.1.7 Demonstrate awareness of emergency procedures related to electrical shock.	10.1.1.7 →	11A.1.1.7 →	11B.1.1.7 →	11C.1.1.7 →
9.1.1.8 Demonstrate awareness of shop safety procedures.	10.1.1.8 →	11A.1.1.8 →	11B.1.1.8 →	11C.1.1.8 →
9.1.1.9 Demonstrate awareness of accident reporting procedures.	10.1.1.9 →	11A.1.1.9 →	11B.1.1.9 →	11C.1.1.9 →
	10.1.1.10 Demonstrate awareness of the rights and responsibilities of employees, employers, and supervisors under the Workplace Health and Safety Act (Manitoba).	11A.1.1.10 →	11B.1.1.10 →	11C.1.1.10 →

9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 1:** Describe and apply appropriate **health and safety** practices. *(continued)*

**GLO 1.1:** Describe and apply appropriate **health and safety** practices. *(continued)*

	10.1.1.11 Demonstrate awareness of the rights and responsibilities of employees, employers, and supervisors as they relate to the right to refuse work as described in the Workplace Health and Safety Act (Manitoba).	11A.1.1.11 →	11B.1.1.11 →	11C.1.1.11 →
	10.1.1.12 Identify the safety requirements as they apply to WHMIS for products used in an electronics technology facility.	11A.1.1.12 →	11B.1.1.12 →	11C.1.1.12 →

<b>9037</b> <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	<b>9038</b> <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	<b>9039</b> <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	<b>9048</b> <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	<b>9049</b> <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 2:** Demonstrate the **identification, selection, utilization, and maintenance** of **tools** and **materials**.

**GLO 2.1:** Demonstrate the **identification** and **selection** of tools and materials.

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9.2.1.1 Identify and select appropriate tools and materials.	10.2.1.1 →	11A.2.1.1 →	11B.2.1.1 →	11C.2.1.1 →
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**GLO 2.2:** Demonstrate the **utilization** of tools and materials.

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9.2.2.1 Demonstrate the appropriate utilization of tools and materials.	10.2.2.1 →	11A.2.2.1 →	11B.2.2.1 →	11C.2.2.1 →
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**GLO 2.3:** Demonstrate the **maintenance** of tools and materials.

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9.2.3.1 Demonstrate the appropriate maintenance of tools and materials.	10.2.3.1 →	11A.2.3.1 →	11B.2.3.1 →	11C.2.3.1 →
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9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 3:** Demonstrate the **identification, selection, value determination, and utilization** of **components**.

**GLO 3.1:** Demonstrate the **identification** and **selection** of components.

9.3.1.1 Identify and select appropriate components.	10.3.1.1 →	11A.3.1.1 Identify and select appropriate components used in AC circuits.	11B.3.1.1 Identify and select appropriate semiconductor signal devices.	11C.3.1.1 Identify and select appropriate semiconductor power devices.
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**GLO 3.2:** Demonstrate the appropriate **value determination** of components.

9.3.2.1 Determine values of components.	10.3.2.1 →	11A.3.2.1 →	11B.3.2.1 →	11C.3.2.1 →
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**GLO 3.3:** Demonstrate the appropriate **utilization** of components.

9.3.3.1 Demonstrate the appropriate utilization of components.	10.3.3.1 →	11A.3.3.1 Demonstrate the appropriate utilization of components used in AC circuits.	11B.3.3.1 Demonstrate the appropriate utilization of semiconductor signal devices.	11C.3.3.1 Demonstrate the appropriate utilization of semiconductor power devices.
	10.3.3.2 Describe the purpose of fuses and circuit breakers.			

<b>9037</b> <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	<b>9038</b> <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	<b>9039</b> <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	<b>9048</b> <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	<b>9049</b> <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 4:** Demonstrate the **utilization and maintenance** of **equipment**.

**GLO 4.1:** Demonstrate the **utilization and maintenance** of **equipment other than diagnostic equipment**.

9.4.1.1 Demonstrate the appropriate utilization and maintenance of equipment other than diagnostic equipment.	10.4.1.1 →	11A.4.1.1 →	11B.4.1.1 →	11C.4.1.1 →
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**GLO 4.2:** Demonstrate the **utilization and maintenance** of **diagnostic equipment**.

9.4.2.1 Demonstrate the appropriate utilization and maintenance of diagnostic equipment (i.e., VOM).	10.4.2.1 →	11A.4.2.1 Demonstrate the appropriate utilization and maintenance of signal generators.  11A.4.2.2 Demonstrate the appropriate utilization and maintenance of oscilloscopes.  11A.4.2.3 Demonstrate an understanding of the difference between measuring DC quantities and AC quantities with a VOM.
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9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 5:** Demonstrate **schematic reading**.

**GLO 5.1:** Read, understand, and interpret **schematic diagrams**.

9.5.1.1 Read, understand, and interpret basic schematic diagrams.	10.5.1.1 →	11A.5.1.1 Read, understand, and interpret schematic diagrams related to AC circuits.	11B.5.1.1 Read, understand, and interpret schematic diagrams related to semiconductor signal devices.	11C.5.1.1 Read, understand, and interpret schematic diagrams related to semiconductor power devices.
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**GLO 5.2:** Demonstrate **rendering**.

9.5.2.1 Render basic schematic diagrams.	10.5.2.1 →	11A.5.2.1 Render schematic diagrams.	11B.5.2.1 →	11C.5.2.1 →
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**GLO 5.3:** Demonstrate **breadboarding**.

9.5.3.1 Demonstrate the appropriate use of solderless breadboards at a basic level.	10.5.3.1 Demonstrate the appropriate utilization of components.	11A.5.3.1 Demonstrate the appropriate use of solderless breadboards.  11A.5.3.2 Demonstrate the appropriate method of enclosing electronics projects that use line voltage.	11B.5.3.1 →	11C.5.3.1 →
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9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 6:** Demonstrate an understanding of **electrical theory** and the **analysis of electrical circuits**.

**GLO 6.1:** Demonstrate an understanding of **electrical theory**.

9.6.1.1 Demonstrate an understanding of material sciences (i.e., conductors, semi-conductors, insulators).	10.6.1.1 →	11A.6.1.1 Explain the function and construction of inductors.	11B.6.1.1 Demonstrate an understanding of semiconductor theory.	11C.6.1.1 Demonstrate an understanding of how thyristors work (i.e., SCR, triac, diac).
9.6.1.2 Demonstrate an understanding of the four electrical quantities (voltage, current, resistance, and power).	10.6.1.2 →	11A.6.1.2 Calculate the total inductance of series and parallel inductive networks.	11B.6.1.2 Demonstrate an understanding of the difference between N-type and P-type semiconductor material.	11C.6.1.2 Demonstrate an understanding of a PUT device as used in power circuits.
9.6.1.3 List sources of electrical energy.	10.6.1.3 →	11A.6.1.3 Demonstrate an understanding of how magnetism influences inductance.	11B.6.1.3 Demonstrate an understanding of how the junction between N-type and P-type material influences current flow.	
9.6.1.4 Demonstrate an understanding of the parts of a basic circuit and direction of electron flow.	10.6.1.4	11A.6.1.4 Demonstrate an understanding of how magnetism generates electricity (i.e., alternators, DC generators).	11B.6.1.4 Demonstrate an understanding of how a signal diode works.	

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**Goal 6:** Demonstrate an understanding of **electrical theory** and the **analysis of electrical circuits**. *(continued)*

**GLO 6.1:** Demonstrate an understanding of **electrical theory**. *(continued)*

9.6.1.5 Demonstrate an understanding of Ohm's Law.	10.6.1.5 Demonstrate an understanding of different cell configurations and how the configurations affect voltage and the life of the battery.	11A.6.1.5 Demonstrate an understanding of how electric current produces an electric field.	11B.6.1.5 Demonstrate an understanding of how zener diodes work.
9.6.1.6 Explain the function of resistors, potentiometers, and rheostats.	10.6.1.6 Demonstrate an understanding of different voltaic cell chemistries.	11A.6.1.6 Demonstrate an understanding of the difference between AC and DC current and voltage.	11B.6.1.6 Demonstrate an understanding of how rectification is accomplished with diodes (i.e., full wave, half wave).
9.6.1.7 Demonstrate an awareness of the difference between series and parallel circuits.	10.6.1.7 Demonstrate an understanding of the parts of a basic circuit and the direction of electron flow.	11A.6.1.7 Demonstrate an understanding of the characteristics of an AC waveform.	11B.6.1.7 Demonstrate an understanding of how a zener diode regulates power supply output.
9.6.1.8 Explain the function of capacitors.	10.6.1.8 Demonstrate an understanding of Ohm's Law.	11A.6.1.8 Demonstrate an understanding of the relationship between DC voltage and an RMS value.	11B.6.1.8 Demonstrate an understanding of how transistors operate (i.e., bipolar, field effect, and unijunction, MOSFET).

<b>9037</b> <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	<b>9038</b> <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	<b>9039</b> <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	<b>9048</b> <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	<b>9049</b> <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 6:** Demonstrate an understanding of **electrical theory** and the **analysis of electrical circuits**. *(continued)*

**GLO 6.1:** Demonstrate an understanding of **electrical theory**. *(continued)*

10.6.1.9 Explain the function of resistors, potentiometers, and rheostats.

11A.6.1.9 Demonstrate an understanding of phase relationships.

10.6.1.10 Demonstrate an understanding of the difference between series, parallel, and combination circuits.

11A.6.1.10 Demonstrate an understanding of how frequency affects inductance and capacitance.

10.6.1.11 Explain the function and construction of capacitors.

11A.6.1.11 Demonstrate an understanding of how inductive and capacitive reactance affects current in a purely capacitive or inductive circuit.

9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 6:** Demonstrate an understanding of **electrical theory** and the **analysis of electrical circuits**. *(continued)*

**GLO 6.1:** Demonstrate an understanding of **electrical theory**. *(continued)*

10.6.1.12 Calculate the total capacitance of series and parallel capacitive networks.

11A.6.1.12 Demonstrate an understanding of a purely capacitive or purely inductive AC circuit (i.e., phase relationship, power dissipation).

11A.6.1.13 Demonstrate an understanding of how transformers operate in an AC circuit.

11A.6.1.14 Demonstrate an understanding of high pass, low pass, and band pass filter circuits.

11A.6.1.15 Demonstrate an understanding of resonant circuits.

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**Goal 6:** Demonstrate an understanding of **electrical theory** and the **analysis of electrical circuits.** *(continued)*

**GLO 6.2:** Demonstrate the procedures for **analyzing electrical circuits.**

9.6.2.1 Demonstrate appropriate procedures for measuring electrical quantities with a VOM.	10.6.2.1 →	11A.6.2.1 Demonstrate appropriate procedures for measuring AC quantities with a VOM.	11B.6.2.1 Analyze basic diode circuits.	11C.6.2.1 Analyze thyristor circuits.
	10.6.2.2 Demonstrate appropriate procedures for measuring electrical quantities in various circuit configurations.	11A.6.2.2 Demonstrate appropriate procedures for measuring voltage and frequency with an oscilloscope.	11B.6.2.2 Analyze basic power supply circuits.	11C.6.2.2 Analyze PUT controlled circuits.
	10.6.2.3 Perform analysis of a series circuit.	11A.6.2.3 Analyze RL, RC, and RLC circuits (series and parallel).	11B.6.2.3 Analyze basic power regulation with zener diodes.	
	10.6.2.4 Perform analysis of a parallel circuit.	11A.6.2.4 Analyze the operation of transformers in an AC circuit with respect to power conservation.	11B.6.2.4 Analyze basic transistor circuits.	
	10.6.2.5 Perform analysis of a combination circuit.	11A.6.2.5 Analyze high pass, low pass, and band pass filter circuits.		
	10.6.2.6 Analyze the operation of a capacitor in a DC circuit.	11A.6.2.6 Analyze resonant circuits.		

9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 7:** Demonstrate **soldering skills, fabricating printed circuit boards,** and **selecting and installing** components.

**GLO 7.1:** Demonstrate **soldering** skills.

9.7.1.1 Demonstrate appropriate soldering skills.	10.7.1.1 →	11A.7.1.1 →	11B.7.1.1 →	11C.7.1.1 →
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**GLO 7.2:** Demonstrate the procedures for **selecting** and **installing components.**

9.7.2.1 Appropriately select and install components.	10.7.2.1 →	11A.7.2.1 →	11B.7.2.1 →	11C.7.2.1 →
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**GLO 7.3:** Demonstrate the procedures for **fabricating printed circuit boards.**

9.7.3.1 Fabricate circuit boards.	10.7.3.1 →	11A.7.3.1 →	11B.7.3.1 →	11C.7.3.1 →
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9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 8:** Describe and demonstrate the transferable **cross-curricular** knowledge and skills as they apply to electronics technology.

**GLO 8.1:** Read, interpret, and communicate information.

10.8.1.1 Read, interpret, and communicate information related to electronics technology.	11A.8.1.1 →	11B.8.1.1 →	11C.8.1.1 →
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**GLO 8.2:** Apply the knowledge and skills from **mathematics**.

9.8.2.1 Perform calculations related to the four electrical quantities (voltage, current, resistance, and power).	10.8.2.1 →	11A.8.2.1 Demonstrate an understanding of how a sine wave is generated mathematically.	11B.8.2.1 Demonstrate an understanding of the mathematics required in semiconductor technology.
9.8.2.2 Perform calculations related to Ohm's Law.	10.8.2.2 →	11A.8.2.2 Perform inductance and capacitance calculations using different frequencies.	
9.8.2.3 Perform conversion calculations using scientific notation and industry prefixes (i.e., K, M, $\mu$ )—the last symbol is the Greek letter <i>mu</i> .	10.8.2.3 →		



9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 8:** Describe and demonstrate the transferable **cross-curricular** knowledge and skills as they apply to electronics technology. *(continued)*

**GLO 8.3:** Apply the knowledge and skills from the **sciences**.

9.8.3.1 Define the terms: matter, element, compound, molecule, atom, ion, electron, and valence electron.	10.8.3.1 →	11B.8.3.1 Demonstrate an understanding of the chemistry of semiconductor materials.
9.8.3.2 Demonstrate an understanding of atomic theory, including the parts of the atom.	10.8.3.1 →	
9.8.3.3 Demonstrate an understanding of static electricity.	10.8.3.3 →	

9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 9:** Understand **education, career opportunities, employment conditions,** and **professional organizations** in the electronics industry.

**GLO 9.1:** Understand **education, career opportunities, employment conditions,** and **professional organizations** in the electronics industry.

10.9.1.1 Demonstrate awareness of career opportunities in electronics technology.

11A.9.1.1 Demonstrate an understanding of employment conditions in electronics technology.

11B.9.1.1 Discuss various career opportunities in electronics technology (i.e., engineer, technician, and technologist).

**Goal 10:** Demonstrate awareness of **sustainability** as it pertains to electronics technology.

**GLO 10.1:** Describe the impact of **human sustainability** on the health and well-being of electronics technicians and those who use their products.

10.10.1.1 Discuss the benefits of electronics technology to people's lives.

11B.10.1.1 Discuss how semiconductor technology has made electronics technology more accessible for people.

10.10.1.2 Discuss the long-term health concerns related to the use of materials containing heavy metals, including solder containing lead.

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**Goal 10:** Demonstrate awareness of **sustainability** as it pertains to electronics technology. *(continued)*

**GLO 10.2:** Describe the electronic technology’s sustainability practices and impact on the **environment**.

10.10.2.1 Discuss the impact of discarded electronics equipment on the environment.

11A.10.2.1 Discuss how electronics technology can have a positive impact on the environment.

**Goal 11:** Demonstrate awareness of the **ethical standards and legal issues**.

**GLO 11.1:** Demonstrate awareness of the **ethical standards and legal issues**.

10.11.1.1 Demonstrate awareness of ethical standards.

11A.11.1.1 Discuss the requirements for ethical behaviour in school and the workplace.

<b>9037</b> <b>Exploration</b> <b>of Electronics</b> <b>Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	<b>9038</b> <b>Introduction</b> <b>to Electronics</b> <b>Technology (10)</b> 20S / 20E / 20M	<b>9039</b> <b>Electronics</b> <b>AC Circuit</b> <b>Fundamentals</b> <b>(11A)</b> 30S / 30E / 30M	<b>9048</b> <b>Semiconductor</b> <b>Technology and</b> <b>Signal Devices</b> <b>(11B)</b> 30S / 30E / 30M	<b>9049</b> <b>Semiconductor</b> <b>Power Devices</b> <b>(11C)</b> 30S / 30E / 30M
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**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 one's 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 the ability to accept and follow direction and feedback.	10.12.1.5 →	11A.12.1.5 →	11B.12.1.5 →	11C.12.1.5 →

9037 <b>Exploration of Electronics Technology (9)</b> 15S / 15E / 15M 10S / 10E / 10M	9038 <b>Introduction to Electronics Technology (10)</b> 20S / 20E / 20M	9039 <b>Electronics AC Circuit Fundamentals (11A)</b> 30S / 30E / 30M	9048 <b>Semiconductor Technology and Signal Devices (11B)</b> 30S / 30E / 30M	9049 <b>Semiconductor Power Devices (11C)</b> 30S / 30E / 30M
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**Goal 12:** Demonstrate **employability skills**. *(continued)*

**GLO 12.1:** Demonstrate **fundamental employability skills**. *(continued)*

9.12.1.6 Demonstrate teamwork skills.	10.12.1.6 →	11A.12.1.6 →	11B.12.1.6 →	11C.12.1.6 →
9.12.1.7 Demonstrate the ability to stay on task and effectively use time in class and work environments.	10.12.1.7 →	11A.12.1.7 →	11B.12.1.7 →	11C.12.1.7 →

**GLO 12.2:** Demonstrate an awareness of **cultural proficiency**, and its importance in the workplace.

	10.12.2.1 Demonstrate an awareness of culture.	11A.12.2.1 Discuss how people’s culture affects their values and behaviour.	11B.12.2.1 Discuss the diversity of cultures in society.	
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**GLO 12.3:** Demonstrate **critical thinking skills** in planning, procedures, analysis, and diagnosis.

9.12.3.1 Discuss the need for critical thinking.	10.12.3.1 →	11A.12.3.1 Demonstrate critical thinking skills.	11B.12.3.1 →	
9.12.3.2 Discuss the need for problem-solving skills.	10.12.3.2 →	11A.12.3.2 Demonstrate problem-solving skills.	11B.12.3.2 →	

<p>9037</p> <p><b>Exploration of Electronics Technology (9)</b></p> <p>15S / 15E / 15M 10S / 10E / 10M</p>	<p>9038</p> <p><b>Introduction to Electronics Technology (10)</b></p> <p>20S / 20E / 20M</p>	<p>9039</p> <p><b>Electronics AC Circuit Fundamentals (11A)</b></p> <p>30S / 30E / 30M</p>	<p>9048</p> <p><b>Semiconductor Technology and Signal Devices (11B)</b></p> <p>30S / 30E / 30M</p>	<p>9049</p> <p><b>Semiconductor Power Devices (11C)</b></p> <p>30S / 30E / 30M</p>
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**Goal 13:** Understand the **evolution, technological progression,** and **emerging trends** in electronics technology.

**GLO 13.1:** Describe the **evolution, technological progression,** and **emerging trends** in electronics technology.

10.13.1.1 Demonstrate awareness of the evolution, technological progression, and emerging trends in electronics technology.

10.13.1.2 Discuss the role of nanotechnology in battery and capacitor technology.

11A.13.1.1 Demonstrate awareness of the history behind the widespread use of AC current.

11B.13.1.1 Demonstrate awareness of the evolution, technological progression, and emerging trends in semiconductors.



# GRADE 12 ELECTRONICS TECHNOLOGY

General and Specific Learning  
Outcomes by Goal





# GRADE 12 ELECTRONICS TECHNOLOGY: GENERAL AND SPECIFIC LEARNING OUTCOMES BY GOAL

9050 <b>Digital Devices and Basic Logic (12A)</b> 40S / 40E / 40M	9051 <b>Advanced Digital Systems (12B)</b> 40S / 40E / 40M	9052 <b>Microprocessors (12C)</b> 40S / 40E / 40M	9053 <b>Microprocessor Applications (12D)</b> 40S / 40E / 40M
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**Goal 1:** Describe and apply appropriate **health and safety** practices.

**GLO 1.1:** Describe and apply appropriate **health and safety** practices.

12A.1.1.1 Create and maintain a safe work environment.	12B.1.1.1 →	12C.1.1.1 →	12D.1.1.1 →
12A.1.1.2 Demonstrate awareness of the rights and responsibilities of employees, employers, and supervisors under the Workplace Health and Safety Act (Manitoba).	12B.1.1.2 →	12C.1.1.2 →	12D.1.1.2 →
12A.1.1.3 Demonstrate awareness of the rights and responsibilities of employees, employers, and supervisors as they relate to the right to refuse work as described in the Workplace Health and Safety Act (Manitoba).	12B.1.1.3 →	12C.1.1.3 →	12D.1.1.3 →
12A.1.1.4 Describe and utilize personal protective equipment (PPE) and follow prescribed procedures.	12B.1.1.4 →	12C.1.1.4 →	12D.1.1.4 →

9050 <b>Digital Devices and Basic Logic (12A)</b> 40S / 40E / 40M	9051 <b>Advanced Digital Systems (12B)</b> 40S / 40E / 40M	9052 <b>Microprocessors (12C)</b> 40S / 40E / 40M	9053 <b>Microprocessor Applications (12D)</b> 40S / 40E / 40M
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**Goal 1:** Describe and apply appropriate **health and safety** practices. *(continued)*

**GLO 1.1:** Describe and apply appropriate **health and safety** practices. *(continued)*

12A.1.1.5 Demonstrate an awareness of electrical safety.	12B.1.1.5 →	12C.1.1.5 →	12D.1.1.5 →
12A.1.1.6 Demonstrate an awareness of fire safety.	12B.1.1.6 →	12C.1.1.6 →	12D.1.1.6 →
12A.1.1.7 Recognize and control hazards.	12B.1.1.7 →	12C.1.1.7 →	12D.1.1.7 →
12A.1.1.8 Identify the safety requirements as they apply to WHMIS for products used in an electronics technology facility.	12B.1.1.8 →	12C.1.1.8 →	12D.1.1.8 →
12A.1.1.9 Demonstrate an understanding of how Ohm's law relates to electrical safety.	12B.1.1.9 →	12C.1.1.9 →	12D.1.1.9 →
12A.1.1.10 Demonstrate awareness of emergency procedures related to electrical shock.	12B.1.1.10 →	12C.1.1.10 →	12D.1.1.10 →
12A.1.1.11 Demonstrate awareness of shop safety procedures.	12B.1.1.11 →	12C.1.1.11 →	12D.1.1.11 →
12A.1.1.12 Demonstrate awareness of accident reporting procedures.	12B.1.1.12 →	12C.1.1.12 →	12D.1.1.12 →

9050 <b>Digital Devices and Basic Logic (12A)</b> 40S / 40E / 40M	9051 <b>Advanced Digital Systems (12B)</b> 40S / 40E / 40M	9052 <b>Microprocessors (12C)</b> 40S / 40E / 40M	9053 <b>Microprocessor Applications (12D)</b> 40S / 40E / 40M
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**Goal 2:** Demonstrate the **identification, selection, utilization, and maintenance** of **tools** and **materials**.

**GLO 2.1:** Demonstrate the **identification** and **selection** of tools and materials.

12A.2.1.1 Identify and select appropriate tools and materials.	12B.2.1.1 →	12C.2.1.1 →	12D.2.1.1 →
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**GLO 2.2:** Demonstrate the **utilization** of tools and materials.

12A.2.2.1 Demonstrate the appropriate utilization of tools and materials.	12B.2.2.1 →	12C.2.2.1 →	12D.2.2.1 →
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**GLO 2.3:** Demonstrate the **maintenance** of tools and materials.

12A.2.3.1 Demonstrate the appropriate maintenance of tools and materials.	12B.2.3.1 →	12C.2.3.1 →	12D.2.3.1 →
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9050 <b>Digital Devices and Basic Logic (12A)</b> 40S / 40E / 40M	9051 <b>Advanced Digital Systems (12B)</b> 40S / 40E / 40M	9052 <b>Microprocessors (12C)</b> 40S / 40E / 40M	9053 <b>Microprocessor Applications (12D)</b> 40S / 40E / 40M
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**Goal 3:** Demonstrate the **identification, selection, value determination, and utilization** of components.

**GLO 3.1:** Demonstrate the **identification** and **selection** of components.

12A.3.1.1 Identify and select appropriate components related to digital systems.	12B.3.1.1 →	12C.3.1.1 Identify and select appropriate support components related to microprocessors.	12D.3.1.1 →
12A.3.1.2 Demonstrate an understanding of TTL and CMOS integrated circuits.			

**GLO 3.2:** Demonstrate the appropriate **value determination** of components.

12A.3.2.1 Determine values of components.	12B.3.2.1 →		
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**GLO 3.3:** Demonstrate the appropriate **utilization** of components.

12A.3.3.1 Demonstrate the appropriate utilization of components related to digital systems.	12B.3.3.1 →	12C.3.3.1 Demonstrate the appropriate utilization of components related to microprocessors.	12D.3.3.1 →
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9050 <b>Digital Devices and Basic Logic (12A)</b> 40S / 40E / 40M	9051 <b>Advanced Digital Systems (12B)</b> 40S / 40E / 40M	9052 <b>Microprocessors (12C)</b> 40S / 40E / 40M	9053 <b>Microprocessor Applications (12D)</b> 40S / 40E / 40M
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**Goal 4:** Demonstrate the **utilization and maintenance** of **equipment**.

**GLO 4.1:** Demonstrate the **utilization and maintenance** of **equipment other than diagnostic equipment**.

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12A.4.1.1 Demonstrate the appropriate utilization and maintenance of equipment other than diagnostic equipment.	12B.4.1.1 →	12C.4.1.1 →	12D.4.1.1 →
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**GLO 4.2:** Demonstrate the **utilization and maintenance** of **diagnostic equipment**.

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12A.4.2.1 Demonstrate the appropriate utilization and maintenance of diagnostic equipment related to digital systems.	12B.4.2.1 →	
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**Goal 5: Demonstrate schematic reading.**

**GLO 5.1:** Read, understand, and interpret **schematic diagrams**.

12A.5.1.1 Read, understand, and interpret digital logic diagrams.	12B.5.1.1 →	12C.5.1.1 Read, understand, and interpret flowcharts.	12D.5.1.1 →
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**GLO 5.2:** Demonstrate **rendering**.

12A.5.2.1 Render digital logic diagrams.	12B.5.2.1 →	12C.5.2.1 Render flowcharts.	12D.5.2.1 →
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**GLO 5.3:** Demonstrate **breadboarding**.

12A.5.3.1 Demonstrate the appropriate use of solderless breadboards to construct digital circuits.	12B.5.3.1 →	12C.5.3.1 Demonstrate the appropriate use of solderless breadboards to construct microprocessor systems.	12D.5.3.1 →
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**Goal 6:** Demonstrate an understanding of **electrical theory** and the **analysis of electrical circuits**.

**GLO 6.1:** Demonstrate an understanding of **electrical theory**.

12A.6.1.1 Demonstrate an understanding of the differences between digital and analog signals.	12B.6.1.1 Demonstrate an understanding of counters and shift registers.	12C.6.1.1 Demonstrate an understanding of basic microprocessor architecture.	12D.6.1.1 Demonstrate an understanding of analog and digital comparators.
12A.6.1.2 Demonstrate an understanding of the number systems used in digital logic.	12B.6.1.2 Demonstrate an understanding of encoders and decoders.	12C.6.1.2 Demonstrate an understanding of basic microprocessor output.	12D.6.1.2 Demonstrate an understanding of parallel and serial communication circuits.
12A.6.1.3 Demonstrate an understanding of the various coding schemes used in digital logic (i.e., ASCII, gray).	12B.6.1.3 Demonstrate an understanding of multiplexers and demultiplexers.	12C.6.1.3 Demonstrate an understanding of basic microprocessor input.	12D.6.1.3 Demonstrate an understanding of analog to digital conversion.
12A.6.1.4 Demonstrate an understanding of binary logic (i.e., 0, 1, low, high).	12B.6.1.4 Demonstrate an understanding of displays (i.e., 7-segment display).	12C.6.1.4 Demonstrate an understanding of basic servo control.	12D.6.1.4 Demonstrate an understanding of digital to analog conversion.
12A.6.1.5 Demonstrate an understanding of how voltage levels relate to logic states.		12C.6.1.5 Demonstrate an understanding of RC discharge time as used as a microprocessor input.	12D.6.1.5 Demonstrate an understanding of pulse width modulation.
12A.6.1.6 Demonstrate an understanding of the three basic logic gates.		12C.6.1.6 Demonstrate an understanding of 7-segment LED display control.	12D.6.1.6 Demonstrate an understanding of frequency analysis.

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**Goal 6:** Demonstrate an understanding of **electrical theory** and the **analysis of electrical circuits.** *(continued)*

**GLO 6.1:** Demonstrate an understanding of **electrical theory.** *(continued)*

12A.6.1.7 Demonstrate an understanding of truth table construction.

12A.6.1.8 Demonstrate an understanding of the inverted gates.

12A.6.1.9 Demonstrate an understanding of exclusive OR and NOR gates.

12A.6.1.10 Perform conversions between logic circuits, Boolean equations, and truth tables.

12A.6.1.11 Perform simplifications using Karnaugh maps.

12A.6.1.12 Demonstrate an understanding of various flip-flops (i.e., D-type, JK, RS).

12C.6.1.7 Demonstrate an understanding of the use of light sensors as microprocessor input.

12C.6.1.8 Demonstrate an understanding of signal generation as microprocessor output.

12C.6.1.9 Demonstrate an understanding of microprocessor/digital interfacing.



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**Goal 6:** Demonstrate an understanding of **electrical theory** and the **analysis of electrical circuits**. *(continued)*

**GLO 6.1:** Demonstrate an understanding of **electrical theory**. *(continued)*

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12A.6.1.13 Demonstrate an understanding of clocked and unclocked (synchronous, asynchronous) logic.

12A.6.1.14 Demonstrate an understanding of various clock circuits (i.e., 555 timer).

12A.6.1.15 Demonstrate an understanding of astable and monostable multivibrators.

12A.6.1.16 Demonstrate an understanding of “debouncing.”

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**Goal 6:** Demonstrate an understanding of **electrical theory** and the **analysis of electrical circuits.** *(continued)*

**GLO 6.2:** Demonstrate the procedures for **analyzing electrical circuits.**

12A.6.2.1 Analyze the operation of basic logic gates constructed from diodes and transistors.	12B.6.2.1 Analyze the operation of counters and shift registers constructed from flip-flops.	12C.6.2.1 Analyze the operation of basic microprocessor output.	12D.6.2.1 Analyze the operation of analog and digital comparators.
12A.6.2.2 Analyze the operation of basic logic gates in TTL CMOS ICs.	12B.6.2.2 Analyze the operation of encoders and decoders.	12C.6.2.2 Analyze the operation of basic microprocessor input.	12D.6.2.2 Analyze the operation of parallel and serial communication circuits.
12A.6.2.3 Analyze the operation of flip-flops.	12B.6.2.3 Analyze the operation of multiplexers and demultiplexers.	12C.6.2.3 Analyze the operation of basic servo control.	12D.6.2.3 Analyze the operation of analog to digital converters.
12A.6.2.4 Analyze the operation of different flip-flops constructed from basic gates.	12B.6.2.4 Analyze the operation of displays (i.e., 7-segment display).	12C.6.2.4 Analyze the operation of RC discharge time as used as a microprocessor input.	12D.6.2.4 Analyze the operation of digital to analog converters.
		12C.6.2.5 Analyze the operation of 7-segment LED display control.	12D.6.2.5 Analyze the operation of circuits using pulse width modulation.
		12C.6.2.6 Analyze the operation of the use of light sensors as microprocessor input.	12D.6.2.6 Analyze the operation of frequency analyzers.

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**Goal 6:** Demonstrate an understanding of **electrical theory** and the **analysis of electrical circuits**. *(continued)*

**GLO 6.2:** Demonstrate the procedures for **analyzing electrical circuits**. *(continued)*

12C.6.2.7 Analyze the operation of signal generation as microprocessor output.

12D.6.2.7 Apply pulse width modulation to digital to analog conversion.

12C.6.2.8 Analyze the operation of microprocessor/digital interfacing.

12D.6.2.8 Apply RC time constants to light spectrum analysis.

**GLO 6.3:** Demonstrate an understanding of applied **programming** of microprocessors.

12C.6.3.1 Demonstrate an understanding of basic control and decision structures.

12D.6.3.1 →

12C.6.3.2 Demonstrate an understanding of language-specific microprocessor commands.

12D.6.3.2 →

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**Goal 7:** Demonstrate **soldering skills, fabricating printed circuit boards,** and **selecting and installing** components.

**GLO 7.1:** Demonstrate **soldering** skills.

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12A.7.1.1 Demonstrate appropriate soldering skills.      12B.7.1.1 —→

**GLO 7.2:** Demonstrate the procedures for **selecting** and **installing components.**

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12A.7.2.1 Appropriately select and install components.      12B.7.3.1 —→

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**Goal 8:** Describe and demonstrate the transferable **cross-curricular** knowledge and skills as they apply to electronics technology.

**GLO 8.1:** Read, interpret, and communicate information.

12.C.8.1.1 Demonstrate appropriate documentation by completing a lab report, which includes the following: describing the method, recording and analyzing results, and drawing conclusions.

**GLO 8.2:** Apply the knowledge and skills from **mathematics**.

12.A.8.2.1 Convert between base 10 and the number systems used in digital logic.

**Goal 9:** Understand **education, career opportunities, employment conditions, and professional organizations** in the electronics industry.

**GLO 9.1:** Understand **education, career opportunities, employment conditions, and professional organizations** in the electronics industry.

12A.9.1.1 Demonstrate awareness of the education opportunities in electronics technology.

12B.9.1.1 Demonstrate awareness of the professional organizations in the electronics industry.

12D.9.1.1 Discuss the process for finding employment in the electronics industry.

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**Goal 10:** Demonstrate awareness of **sustainability** as it pertains to electronics technology.

**GLO 10.1:** Describe the impact of **human sustainability** on the health and well-being of electronics technicians and those who use their products.

12C.10.1.1 Discuss how large-scale integration has made electronics technology more powerful and accessible for people.

**GLO 10.2:** Describe the electronic technology’s sustainability practices and impact on the **environment**.

12A.10.2.1 Demonstrate an understanding of the use of electronics in reducing harmful emissions.

**Goal 11:** Demonstrate awareness of the **ethical standards and legal issues**.

**GLO 11.1:** Demonstrate awareness of the **ethical standards and legal issues**.

12A.11.1.1 Discuss ethical standards as they relate to current issues in electronics technology (e.g., cell phone contracts, cablevision or Internet packages, pirating music or videos).

12B.11.1.1 Discuss the legal issues pertaining to current issues in electronics technology (e.g., cell phone contracts, cablevision or Internet packages, pirating music or videos).

12C.11.1.1 Discuss the legal requirements found in the Certified Engineering Technologist’s Code of Ethics.

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**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 one's 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 the ability to accept and follow direction and feedback.	12B.12.1.5 →	12C.12.1.5 →	12D.12.1.5 →
12A.12.1.6 Demonstrate teamwork skills.	12B.12.1.6 →	12C.12.1.6 →	12D.12.1.6 →
12A.12.1.7 Demonstrate the ability to stay on task and effectively use time in class and work environments.	12B.12.1.7 →	12C.12.1.7 →	12D.12.1.7 →

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**Goal 12:** Demonstrate **employability skills**. *(continued)*

**GLO 12.2:** Demonstrate an awareness of **cultural proficiency**, and its importance in the workplace.

12A.12.2.1 Discuss the diversity of cultures in the workplace.	12B.12.2.1 Discuss the need to interact positively with people of different cultures in society and in the workplace.	12C.12.2.1 Discuss the principles of cultural proficiency.
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**GLO 12.3:** Demonstrate **critical thinking skills** in planning, procedures, analysis, and diagnosis.

12A.12.3.1 Demonstrate critical thinking skills.	12A.12.3.2 Use a variety of strategies in order to diagnose and solve problems.
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**Goal 13:** Understand the **evolution, technological progression, and emerging trends** in electronics technology.

**GLO 13.1:** Describe the **evolution, technological progression, and emerging trends** in electronics technology.

12A.13.1.1 Discuss the effect of large scale integration on digital technology.	12C.13.1.1 Demonstrate awareness of the evolution, technological progression, and emerging trends in microprocessors.
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