Manitoba Grade 12C Automotive Technology Advanced Electrical Systems (Course Code 8702) Course Outline

Course Description

This course extends foundational electrical knowledge through diagnostic testing, circuit analysis, wiring repairs, and service of starting, charging, and low-voltage battery systems. Students use schematics, diagnostic flowcharts, measurements, and manufacturer specifications to identify and correct faults. The course also introduces hybrid and electric vehicle designs, high-voltage hazards, and the purpose of specialized safety equipment.

Course Objectives

- Apply safe work practices for electrical and electronic service.
- Apply Ohm's, Kirchhoff's, and Watt's laws to circuits.
- Interpret wiring diagrams, specifications, and diagnostic flowcharts.
- Measure voltage, current, resistance, and voltage drop.
- Diagnose circuit faults using test evidence.
- Repair wires, cables, terminals, and electrical components.
- Service starting, charging, and low-voltage battery systems.
- Identify hybrid and electric vehicle designs and components.
- Explain high-voltage hazards and specialized safety requirements.
- Verify repairs and prepare clear diagnostic documentation.

Course Units

Unit hours are suggested planning allocations totalling 110 hours, including assessment and project work. Adjust to the school timetable. Safety, communication, mathematics, and environmental responsibility are reinforced throughout.

Unit 1: Electrical Safety and Professional Practice

Estimated Time: 10 hours

Topics:

- Electrical hazards, PPE, and safe work procedures
- Battery hazards and safe material handling
- Tool inspection and appropriate test equipment
- Emergency response, housekeeping, and communication
- E-waste, battery disposal, and Indigenous resource perspectives

Assessment: Safety test; equipment inspection activity

Unit 2: Applied Electrical Theory

Estimated Time: 14 hours

Topics:

- Conventional current and electron flow
- Voltage, current, resistance, and power
- Ohm's law, Kirchhoff's laws, and Watt's law
- Series, parallel, and series-parallel circuits
- Circuit calculations and comparison with measurements

Assessment: Circuit calculation test; circuit lab

Unit 3: Schematics and Diagnostic Testing

Estimated Time: 18 hours

Topics:

- Electrical symbols, circuit paths, and connections
- Diagnostic flowcharts and manufacturer specifications
- Multimeter and appropriate test-equipment selection
- Voltage, current, resistance, and voltage-drop tests
- Fault isolation and evidence-based repair decisions

Assessment: Diagnostic lab; schematic interpretation task

Unit 4: Wiring, Cables, and Component Repair

Estimated Time: 16 hours

Topics:

- Wire and cable types, sizes, and applications
- Protection, control, and load devices
- Splicing, terminal replacement, soldering, and crimping
- Approved component repair and replacement
- Inspection and verification of electrical repairs

Assessment: Wiring repair practical; component test

Unit 5: Low-Voltage Battery Systems

Estimated Time: 12 hours

Topics:

- 12-volt battery types and characteristics
- Selection, condition assessment, and specifications
- Battery testing tools and procedures
- Safe servicing and replacement
- Post-service checks and documentation

Assessment: Battery practical; written quiz

Unit 6: Starting and Charging Systems

Estimated Time: 18 hours

Topics:

- Starting and charging components and operation
- System test equipment and service information
- Measurements and interpretation of test results
- Supervised repair and component replacement
- System verification and diagnostic records

Assessment: Starting/charging diagnostic practical

Unit 7: Hybrid and Electric Vehicle Fundamentals

Estimated Time: 14 hours

Topics:

- Series, parallel, and series-parallel hybrid designs
- Hybrid levels and BEV, PHEV, HEV, FCEV, and extended-range designs
- High-voltage battery types and system identification
- Shock, arc-flash, fire, and stored-energy hazards
- Purpose of isolation, tagging, and absence-of-voltage verification
- Specialized PPE, insulated tools, meters, and battery-handling equipment

Assessment: Technology comparison; safety scenario assessment

Unit 8: Advanced Electrical Diagnostic Project

Estimated Time: 8 hours

Topics:

- Confirming an assigned low-voltage electrical concern
- Planning tests from schematics and service information
- Recording results and identifying the fault
- Completing approved repairs and verifying operation
- Presenting a professional diagnostic report

Assessment: Diagnostic project; final report

Assessment Breakdown

The weighting follows the supplied course-outline template; project tasks are adapted to this course.

Component	Weight
Theory Tests & Quizzes	25%
Practical Shop Skills	35%
Labs & Assignments	20%
Culminating Project	10%
Employability & Safety Practices	10%

Required Tools and Equipment

- Digital multimeter and suitable leads
- Appropriate current-measuring and electrical test equipment
- Battery and starting/charging system testers
- Scan tool where required by service information
- Wire strippers, crimpers, terminal tools, and soldering equipment
- Low-voltage circuit trainers and vehicle systems
- Manufacturer schematics, specifications, and flowcharts
- Hybrid/EV training resources and specialized safety equipment for instructor-led identification

Employability Skills

- Workplace safety and responsible decision-making
- Problem-solving, critical thinking, and creativity
- Clear communication, active listening, and teamwork
- Time management, organization, and independent learning
- Professional conduct, inclusion, and respect for others
- Environmental responsibility and global citizenship
- Career awareness within the automotive service industry

Culminating Project

Students will diagnose an assigned low-voltage electrical, starting, charging, or battery-system fault. They will interpret a schematic, plan tests, record measurements, explain the cause, complete an approved repair, and verify operation. A separate hybrid/EV component and hazard analysis will demonstrate introductory technology and safety knowledge; high-voltage work is limited to the instructor's training, authorization, and approved procedures.

Recommended Prerequisite

Grade 12A Electrical Fundamentals and Services or equivalent foundational automotive electrical preparation. This is a suggested preparation pathway, not a provincial prerequisite stated in the supplied curriculum.

Curriculum Reference

Based on Manitoba's Grade 12C Advanced Electrical Systems curriculum (Course Code 8702; supplied auto_gr12C_eng.pdf).

Curriculum alignment: A8 Electrical Systems and Components; A9 Starting and Charging Systems, and Low Voltage Batteries I; A14 Hybrid and Electric Vehicle Systems I.