Cambrian College

Schools of Skilled Training, Engineering Technology & Environmental Studies
Course Outline

We acknowledge and respect that we are gathered on the traditional lands of the Anishnaabe People of Turtle Island and proudly recognize our local host Atikameksheng Anishnawbek. We also recognize the contributions of Wahnapitae First Nation and the Metis Nation of Ontario.

Course Title	Trade Practice I				
Course Code:	HDA1180	Credit Value:	3	Credit Hours:	42
Programs:	HEDC Commercial Vehcile & Heavy Equipment - Dual Credit HTAP Heavy Equipment Techniques				
Equivalencies		Prerequisites		Corequisites	GOM1142

This course may be delivered in a variety of different formats: 100% in-class, 100% online (or a blend of both), videoconferencing, distributed learning or off-campus. Please confirm with your faculty member which format will be used for your section of this course.

General Education Course:	☐	Eligible for PLAR:	☑
Degree Breadth Course:	☐	Experiential Learning:	☐
Research Intensive Course Designation:	☐		

COURSE DESCRIPTION

In this course, students will be able to describe the legal responsibilities of employees and employers relating to safe working practices, protection of the environment, and demonstrate the operation of lifting, rigging, blocking and safety equipment according to government safety and environmental legislation. They will learn how to use precision measuring tools following manufacturers' recommendations, perform fastening device installation and removal procedures. The students will also perform the maintenance and repair procedures for bearings, seals, and sealants and operate heating and cutting equipment following manufacturers' recommendations, government regulations, and safe work practices.

Date: June 11, 2026

Approved by:

ANGELA GILMORE
Chair, Schools Of Skilled Training, Engineering Technology & Environmental Studies

Effective: Fall 2026, Winter 2027, Spring 2027

RELATIONSHIP TO PROGRAM VOCATIONAL LEARNING OUTCOMES

PROGRAM LEVEL	
This course contributes to your program by allowing you to demonstrate the following vocational learning outcomes:	
Program(s)	**Vocational Learning Outcomes**
Commercial Vehcile & Heavy Equipment - Dual Credit	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Disassemble and assemble heavy duty equipment components to required specifications. 3. Prepare logs, records, and documentation to appropriate standards. 4. Apply communication skills to improve customer service. 5. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.
Heavy Equipment Techniques - Apprenticeship	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Disassemble and assemble heavy duty equipment components to required specifications. 3. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 4. Prepare logs, records, and documentation to appropriate standards. 5. Apply communication skills to improve customer service. 6. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.

COURSE CURRICULUM

Topics/Concepts Covered in This Course

- S1241.1 Occupational Health and Safety
- S1241.2 Precision Measuring Tools
- S1241.3 Fastening Devices and Torquing Procedures
- S1241.4Bearings, Seals, and Sealants
- S1241.5 Oxy-Fuel Processes

COURSE LEVEL: Learning Outcomes and Objectives		
To earn credit for this course, you must reliably demonstrate your ability to:		
Learning Outcome	**Objectives**	**Competency Profile**
1. Explain the fundamentals of safe practices in the workplace.	1.1 Describe the protective clothing and equipment used in the Industry - CSA approved eye, foot, hearing and hand protection - Breathing and ventilation - housekeeping and cleanliness - dangers of wearing jewellery and loose clothing - fire protection - extinguisher applications - prevention - lifting techniques - posture - procedures - environmental protection - disposal of antifreeze, fuels, oils, cleaning solvents, tires, and batteries. - air quality and ventilation - discharge of vapours 1.2 Identify the legal responsibilities of employees and employers relating to government legislation for relevant workplace activities. - Occupational Health and Safety Act - Workplace Hazardous Material Information System (WHMIS) - Apprenticeship and Certification Act - Environment Protection Act - environment responsibilities - storage of hazardous material - volatile liquids - cleaning agents - acids	S1241.1

Learning Outcome	Objectives	Competency Profile
	1.3 Demonstrate inspection, testing, and operating procedures for lifting rigging and blocking equipment following manufacturers' recommended procedures and government regulations. - lifting devices - hoists - legal lifting requirement for overhead crane operation - refer to O. Reg. 631/94 section 3 of Trades Qualification and Apprenticeship Act - jacks - chain lifts - blocking devices - stands - safety locks and lockouts - rigging devices - rope - chains - belts - brackets and hooks - fastening procedures	
2. Explain the fundamentals of precision and non-precision measuring tools.	2.1 Use both système international d'unités (s.i.) and Imperial -measurements and conversions -accuracy and reliability vs. the cost of measuring tools 2.2 Identify the construction features, composition, types, styles, and application of precision measuring tools. micrometers -inside, outside, depth -small hole gauges -callipers precision vernier, non-precision -telescoping gauges -straight edge -thickness gauge (feeler gauges) -dial indicators	S1241.2

Learning Outcome	Objectives	Competency Profile
	2.3 Identify various types of Torque wrenches -click type -dial type -flexing beam type -electronic type -adapters and extensions 2.4 Describe the principles of operation of precision measuring tools. micrometer -inside, outside, depth -small hole gauges -callipers -precision vernier, non-precision -telescoping gauges -straight edge -thickness gauge (feeler gauges) -dial indicators 2.5 Perform manufacturer maintenance and calibration procedures for precision and non-precision measuring tools, and Measure components. 2.6 Describe basic tool maintenance procedures -storage -lubrication -methods of restoring critical surfaces -adjustments, calibration 2.7 Perform precision measuring activities on various components -crankshaft -camshaft	

Learning Outcome	Objectives	Competency Profile
3. Explain the fundamentals of fastening devices and torquing procedures.	3.1 Describe thread terminology, fastener grades/application. -Society of Automotive Engineers (SAE) standards, système international d'unités (s.i.) -yield strength, tensile strength, shear strength, and fatigue -grade, pitch, threads per inch -diameter, length, and head size -thread locking compounds -anti-seize compounds -sealant applications -factors that affect torque/tension -lubrication -temperature -length and diameter -grade of fastener -condition of threads -composition of material 3.2 Identify the construction, composition, types, styles, and application of fastening devices. -bolts -nuts -screws -studs -locking devices -pins -rivets -keys -washers -retaining rings -thread repair devices -thread sealants -thread locking compounds -grade application criteria	S1241.3

Learning Outcome	Objectives	Competency Profile
	3.3 Describe the principles of operation of fastening devices. -torque-to-yield fasteners -torque effects of wet, dry, and clean threads -locking devices -thread repair principles -temperature -compatibility -clamping force -effect of fastener grade on strength, flexibility, and torque 3.4 Perform installation and removal procedures following manufacturers' recommendations for fastening devices. -test fastener strength and torque requirements for wet and dry applications -demonstrate thread repair procedures for: -freeing seized threads, removal of broken fasteners -installation of thread repair and locking devices 3.5 Perform metal working practices for: -drilling -tapping -hacksawing -filing -sealant selection, removal, and installation practices -thread locking and anti-seize application -torquing of fasteners to manufacturers' recommendations	

Learning Outcome	Objectives	Competency Profile
4. Explain the purpose and fundamentals of bearings, seals, and sealants.	4.1 Describe the function of bearings as it relates to: -friction -temperature -lubrication -bearing loads -axial loads -radial loads -preload -endplay -pressure -seals -dynamic -static -sealants -anaerobic -non-anaerobic -gaskets 4.2 Indentify the various cleaning and surface preparation products. 4.3 Identify the construction features, composition, types, styles, and application of bearings, seals, and sealants. -friction bearings/ anti-friction bearings -ball -roller -needle -code identification -seals -dynamic -static -sealants -anaerobic -non-anaerobic -gaskets -cleaning and surface preparation products	S1241.4

Learning Outcome	Objectives	Competency Profile
	4.4 Describe the principles of operation of bearings, seals, and sealants. -friction bearings -hydrodynamic suspension -anti-friction bearings -ball -roller -needle -temperature -lubrication -bearing adjustments -preload -end play -pressure -seals -dynamic -static -sealant -anaerobic -non-anaerobic -gaskets -yield -creep -speciality sealant -cleaning and surface preparation products 4.5 Demonstrate inspection and testing procedures following manufacturers' recommendations for bearings, seals, and sealants. -scoring -spalling -over-heating -noise -vibration -electrical damage (arcing) -clearance seal inspection and testing for: -migration -leakage of seals or gaskets -shaft and housing bore condition -fluid compatibility	

Learning Outcome	Objectives	Competency Profile
	4.6 Recommend reconditioning or repairs following manufacturers' recommendations for bearings, seals, and sealants. removal and installation procedures for: -bearings -seals -sealants -correct selection of sealant for application -gaskets	
5. Explain the purpose and fundamentals of heating and cutting practices.	5.1 Describe the operation for oxy-fuel gases. -eye, face, hand, foot, and clothing protection -set-up, ignition, and shutdown sequence -cylinder handling/storage -fire prevention -combustible material (e.g. butane lighter risks) -flashback -backfire -removing damaged or broken fasteners -using heat to free seized fasteners 5.2 Identify the construction features, types, and application of oxyacetylene heating and cutting equipment. -cylinders -identification features -pressure regulator -manual valves -manifold systems -gauges and hoses -cutting attachments -tips -cutting -heating -torch body -heating tips -flashback arresters	S1241.5

Learning Outcome	Objectives	Competency Profile
	5.3 Describe the principles of operation of oxyacetylene heating and cutting equipment. -cylinders -pressure regulator -manual valves -manifold systems -gauges and hoses -cutting attachments -torch body -tips -cutting -heating -flashback arresters 5.4 Outline the manufacturers ' system maintenance procedures for oxyacetylene heating and cutting equipment. -cylinders -approved storage and securement -gauges and hoses -manual valves -pressure regulators -cutting attachments -tips -cutting -heating -torch body -manifold	

Learning Outcome	Objectives	Competency Profile
	5.5 Perform basic heating and cutting procedures following manufacturers' recommendations. -equipment set-up, ignition, and shutdown sequence -oxygen and acetylene pressure settings -ignition procedures -select heating and cutting tips -observe tip angle, travel speed, and gap -demonstrate awareness of potential damage from heating or cutting to surrounding materials -identify potential risks for altering metallurgical properties -perform appropriate pressure settings, ignition, and flame adjustments for specific heating and cutting tasks -remove damaged fasteners -heating and removing procedures of seized fasteners	

Essential Employability Skills

Communication
- communicate clearly in written, spoken, and visual form that fulfills purpose/ needs of audience.
- respond to written, spoken, or visual messages in a manner that ensures effective communication.

Numeracy
- execute mathematical operations accurately.

Critical Thinking and Problem Solving
- apply a systematic approach to solve problems.
- use a variety of thinking skills to anticipate and solve problems.

Information Management
- analyze, evaluate, and apply relevant information from a variety of sources.

Interpersonal
- show respect for the diverse opinions, values, belief systems, and contributions of others.
- interact with others in groups in ways that contribute to effective working relationships.

Personal
- manage the use of time and other resources to complete projects.
- take responsibility for one's own actions, decisions, and consequences.

Delivery Method

- Classroom: Course is delivered through scheduled synchronous teaching that may be face-to-face and/or virtual.

Learning Activities

- Lectures
- Class Discussions
- Labs
- Group Work
- Self-Directed Learning
- Presentations
- Scenario Testing
- In-Class Exercises
- One-to-One Instruction
- eLearning Components

Resources Required

Additional Supplies

Coveralls
Fire Resistant one piece coveralls
Estimated Cost: 150

Laptop
Capable of running excel, word, paint and internet
Estimated Cost: 1500

CDX Fundamentals of Mobile Heavy Equipment
Estimated Cost: 200

Cengage Heavy Equipment Systems 4th Edition
Estimated Cost: 200

Safety Glasses
CSA approves, with clear lenses
Estimated Cost: 50

Safety Boots
CSA approved, 8" high steel toe
Estimated Cost: 200

Evaluation Plan

Grading Scheme

A	80%	-	100%
B	70%	-	79%
F	0%	-	69%

Evaluation Method	Value (%)
Test/Exam	**30%**
2 Test/Exams of equal value	

This is an important document and should be saved for future reference. It may be needed for certification, credit transfer and employment purposes.
Published: June 26, 2026

Evaluation Method	Value (%)
Quizzes	**30%**
3 Scheduled Moodle Activities, consisting of Quizzes, and Theory Assignments of equal value.	
Applied Activities (G)	**40%**
4 Scheduled Lab Evaluations of equal value.	

ADDITIONAL INFORMATION

A course outline is the College's commitment to the students. It supports educators, students, employers, and external partners in determining the depth of knowledge and level of performance that a student will be able to demonstrate upon successful completion of a course. Both instructor and student are obligated to follow the content of the course outline. It is your responsibility to meet these outcomes as assigned.

Note: You should maintain a copy of this course outline for your records. You may require this course outline if you seek transfer credits or further studies at other institutions.

Cambrian Email Addresses

All email correspondence with currently registered students must be via the students' College-issued email, as per the College's IT Acceptable Use Policy. Students must familiarize themselves with the IT Acceptable Use Policy, as it outlines the acceptable use of College information systems and technology, and mitigates risks to the College's IT infrastructure.

Bring Your Own Device (BYOD) and Apps Anywhere

Cambrian College is a BYOD institution, which means that students bring the device of their choice that meets program-specific minimum technology requirements. Program-specific minimum technology requirements can be viewed on program pages on the Cambrian College website. AppsAnywhere is an easy-to-use app store-like platform providing students with a way to access their College apps and software on demand, anywhere, anytime both on and off campus. These both enrich the student learning experience in and out of the classroom, while providing maximum flexibility.

Policies

It is the student's responsibility to be aware of the College's policies. Policies, procedures and forms can be found on the College website.

Academic and Student Services

Cambrian has a variety of student and academic services to support students during their academic journey at the College.

- • Academic Integrity Office
- Academic Success Centre
- Bookstore and Campus Store
- International Student Support Services
- KPMG Pride Centre
- Career Centre
- Registrar's Office (Enrolment Centre)
- First Step Centre
- Accessibility Services
- Library
- Pathways
- Available Scholarships and Bursaries

- Cambrian Student Council (CSC)
- Cambrian Indigenous Student Circle (CISC)
- Cambrian Athletic Association (CAA)
- Student Life Centre
- Test Centre
- The Learning Centre [Tutoring Services]
- Wabnode Centre for Indigenous Services
- Women's Resource Centre

Copyright

Copyright is the exclusive legal right given to a creator to reproduce, publish, sell, or distribute his/her work. All members of the Cambrian community are required to comply with Canadian copyright law, which governs the reproduction, use and distribution of copyrighted materials. This means that the copying, use and distribution of copyright-protected materials, regardless of format, are subject to certain limits and restrictions. For example, activities such as photocopying or scanning an entire textbook or uploading class materials to a course sharing site are prohibited.

See the Cambrian Library website for additional information regarding copyright and for details on allowable limits.

Audio/Visual Capture

Sounds and images from this class, and contributions made by a participant, virtually or in-person, are recorded under the authority of the *Ontario Colleges of Applied Arts and Technology Act, 2002*. The main purpose of these recordings is to allow students enrolled in the course to review content and engage in activities, whether they attend any given class in person, virtually, or at all. Class recordings are for personal use only and shall not be shared or transferred. Faculty may also review these recordings to prepare for future classes, evaluate students, collaborate in program reviews, or provide feedback to faculty and/or students. Any questions about the use of multimedia recordings may be addressed to your respective Dean.

Equity, Diversity, and Inclusivity

Cambrian is committed to building and preserving an equitable, diverse, and inclusive learning community where students, faculty, and staff may achieve their full potential in an environment characterized by equality of respect and opportunity. All students and employees have the right to live and work in an environment that is free from discrimination and harassment. Therefore, Cambrian College will not tolerate any form of discrimination or harassment in its employment, education, accommodation, or business dealings. For more information, please visit: Equity, Human Rights, and Accessibility.

Prior Learning Assessment and Recognition (PLAR)

Students wishing to have work or life experience that meets course learning outcomes considered for credit through Prior Learning Assessment and Recognition should email the Enrolment Centre at records@cambriancollege.ca.

Transfer Credit

Students wishing to have courses from other programs or institutions assessed for equivalency and/or transfer credit should visit the Transfer Credits page on the Cambrian website. The student should maintain a copy of this course outline for their records. Students may require this course outline if seeking transfer credits or further studies at other institutions.

Test Proctoring at Cambrian

Many courses include major tests and/or final exams. The practice at Cambrian requires that these types of test situations involve proctoring to ensure academic integrity. Online tests/exams may employ a proctoring services to enable you to take your exam from a location of your choosing

within a period specified by your instructor. When you are taking an online test/exam, the proctoring service may capture your video, screen, audio, and web surfing data to protect academic integrity. Cambrian College collects, uses, discloses, and retains personal information in compliance with the *Freedom of Information and Protection of Privacy Act (FIPPA)*. Your personal information is being collected under the authority of the *Ontario Colleges of Applied Arts and Technology Act S.O. 2002, c.8, Sched. F*. This information will be used for the purpose of administering a test/exam through an online proctoring service acting as an authorized agent of the College. Please refer to Cambrian's Official Student Records Policy for more details. If you have any questions regarding the collection of your personal information, please contact Vice President Academic, Cambrian College, 1400 Barry Downe Rd., Sudbury ON P3A 3V8, 1-705-566-8101 ext. 6245.

Cambrian College

Schools of Skilled Training, Engineering Technology & Environmental Studies
Course Outline

We acknowledge and respect that we are gathered on the traditional lands of the Anishnaabe People of Turtle Island and proudly recognize our local host Atikameksheng Anishnawbek. We also recognize the contributions of Wahnapitae First Nation and the Metis Nation of Ontario.

Course Title	Engine Systems I				
Course Code:	HDA1181	Credit Value:	3	Credit Hours:	42
Programs:	HEDC Commercial Vehcile & Heavy Equipment - Dual Credit HTAP Heavy Equipment Techniques				
Equivalencies		Prerequisites		Corequisites	GOM1142

This course may be delivered in a variety of different formats: 100% in-class, 100% online (or a blend of both), videoconferencing, distributed learning or off-campus. Please confirm with your faculty member which format will be used for your section of this course.

General Education Course:	☐	Eligible for PLAR:	☑
Degree Breadth Course:	☐	Experiential Learning:	☐
Research Intensive Course Designation:	☐		

COURSE DESCRIPTION

In this course, students will be able to explain the terminology used on engine blocks, cylinder heads, valve train and power train components. They will also be able to describe and identify the operating principles of engine blocks, cylinder heads, valve trains and power train components. Finally, the students will perform engine system maintenance, inspection and service procedures, following manufacturer's recommendations.

Date: June 11, 2026

Approved by:

ANGELA GILMORE
Chair, Schools Of Skilled Training, Engineering Technology & Environmental Studies

Effective: Fall 2026, Winter 2027, Spring 2027

RELATIONSHIP TO PROGRAM VOCATIONAL LEARNING OUTCOMES

PROGRAM LEVEL	
This course contributes to your program by allowing you to demonstrate the following vocational learning outcomes:	
Program(s)	**Vocational Learning Outcomes**
Commercial Vehcile & Heavy Equipment - Dual Credit	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Identify, inspect, and test basic heavy duty equipment engine components and systems in compliance with manufacturers' recommendations. 3. Disassemble and assemble heavy duty equipment components to required specifications. 4. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 5. Prepare logs, records, and documentation to appropriate standards. 6. Apply communication skills to improve customer service. 7. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.
Heavy Equipment Techniques - Apprenticeship	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Identify, inspect, and test basic heavy duty equipment engine components and systems in compliance with manufacturers' recommendations. 3. Disassemble and assemble heavy duty equipment components to required specifications. 4. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 5. Prepare logs, records, and documentation to appropriate standards. 6. Apply communication skills to improve customer service. 7. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.

COURSE CURRICULUM

Topics/Concepts Covered in This Course

- S1243.1 Engine Operation Fundamentals
- S1243.2 Engine Component Fundamentals
- S1243.3 Engine System Identification, Maintenance and Service Procedures

COURSE LEVEL: Learning Outcomes and Objectives	
To earn credit for this course, you must reliably demonstrate your ability to:	
Learning Outcome	**Objectives**
1. Explain the fundamentals of engine blocks, cylinder heads, valve train and power train components.	1.1 Explain the fundamentals of engine assemblies. -otto cycle -diesel cycle -spark ignition -compression ignition -two-stroke cycle -four-stroke cycle
2. Explain the terminology used on engine blocks, cylinder heads, valve train and power train components.	2.1 Describe engine terminology. -inertia heat -heat -energy -pressure -force -torque -bore -stroke -swept volume -displacement -clearance volume -compression ratio -volumetric efficiency -mechanical efficiency -thermal efficiency -power -indicated horsepower -brake horsepower -society of Automotive Engineers (SAE) horsepower

Learning Outcome	Objectives
3. Identify the principles of operation of engine assemblies.	3.1 Describe engine terminology. -otto cycle -diesel cycle -two-stroke cycle -four-stoke cycle -spark ignition -compression ignition -combustion dynamics -process of combustion -combustion chamber design -expansion coefficients -air/fuel ratios -perform basic engine calculations -swept volume -compression ratio -compression pressure -indicated horsepower -brake horsepower -Society of Automotive Engineers (SAE) horsepower -mechanical efficiency -volumetric efficiency -thermal efficiency
4. Explain the purpose and fundamentals of engine block, cylinder head, valve train, and power train components.	4.1 Describe engine terminology. - engine blocks - design features - configuration - gear train assemblies - cylinder heads - valve train assembly - in block cam - overhead cam

Learning Outcome	Objectives
5. Identify and describe the functions, types, styles, and applications of engine blocks, cylinder heads, valve trains and power train components.	5.1 Describe engine terminology. - cylinder blocks - design feature - top deck surface - main bearing bores - configuration - V-block - inline - sleeves / liners - wet - dry integral - air cooled - liquid cooled - counter bore - flywheel vibration dampers - crankshaft - connecting rods - piston pins - pistons - piston rings - camshaft and timing gears - cylinder head types - overhead cam - L-head - cylinder head and valve train assembly - valves, seats, guides, seals, springs and retainers - rocker assemblies, valve bridges, pushrods, lifters, camshafts - drive mechanisms - injector sleeves and fuel manifolds

Learning Outcome	Objectives
6. Explain the terms and maintenance procedures used to service engine systems.	6.1 Describe engine terminology. - lubrication system - lubricating oil ratings - Society of Automotive Engineers (SAE) - American Petroleum Institute (API) - OEM vs. generic aftermarket specifications - lubricating circuits - bypass valve - relief valve - filter types - bypass - full flow - centrifugal - cooling system - coolant handling and waste disposal - fan drives - shroud and fan enclosure - fan clutches - coolant pumps - coolant types - OEM vs. generic aftermarket specifications - radiator coolant level switches - hoses, clamps, and belts - intake systems - pre-cleaners - dry-type air cleaners - wet-type air cleaners - air to air after coolers - air to coolant after coolers - air intake heaters - air intake restriction indicators - exhaust systems - turbo chargers - mufflers - pipes - accessory drive systems - belts - pulleys - gear drives - fuel delivery systems - filters - water separators - water in fuel (WIF) - priming procedure

Learning Outcome	Objectives
7. Perform inspections, maintenance and basic service procedures following manufacturers' recommendations for engine lubrication, cooling, intake, exhaust, and fuel systems.	7.1 Perform inspections, maintenance and basic service for: - servicing oil and oil filters - handling and disposal procedures - pressure test - inspection of lubrication system - determining oil condition - sampling procedure - identify contaminants - bypass filter service procedure - demonstrate the inspection and maintenance procedures for: - radiator condition and pressure testing - radiator and heater hose condition - radiator cap condition and pressure testing - testing pH level of coolant - testing coolant strengths and condition - testing supplemental coolant additives level - testing coolant total dissolved solids level - intake systems - visual inspection - leak testing - air inlet restriction testing - filter servicing - exhaust systems - visual inspection - noise and leak inspection - diesel particulate filter (DPF) - aqueous urea injection system - fuel system - fuel handling and waste disposal - filter replacement - servicing water separators - fuel priming - fuel tank water draining - OEM maintenance tracking software

Essential Employability Skills

Communication
- communicate clearly in written, spoken, and visual form that fulfills purpose/ needs of audience.
- respond to written, spoken, or visual messages in a manner that ensures effective communication.

Numeracy
- execute mathematical operations accurately.

Critical Thinking and Problem Solving
- apply a systematic approach to solve problems.
- use a variety of thinking skills to anticipate and solve problems.

Information Management
- locate, select, organize, and document information using appropriate technology and info systems.
- analyze, evaluate, and apply relevant information from a variety of sources.

Interpersonal
- show respect for the diverse opinions, values, belief systems, and contributions of others.
- interact with others in groups in ways that contribute to effective working relationships.

Personal
- manage the use of time and other resources to complete projects.
- take responsibility for one's own actions, decisions, and consequences.

Delivery Method

- Classroom: Course is delivered through scheduled synchronous teaching that may be face-to-face and/or virtual.

Learning Activities

- Lectures
- Class Discussions
- Labs
- Group Work
- Self-Directed Learning
- Physical Activity
- In-Class Exercises
- Small Group Instruction
- One-to-One Instruction
- eLearning Components

Resources Required

Additional Supplies

Coveralls
Fire resistant one piece coveralls
Estimated Cost: 150

CDX Engine Manual
Estimated Cost: 200

Safety Glasses
CSA clear safety glasses
Estimated Cost: 50

Safety Boots
8" high, CSA steel toe safety boots
Estimated Cost: 200

Evaluation Plan

Grading Scheme

A	80%	-	100%
B	70%	-	79%
F	0%	-	69%

Evaluation Method	Value (%)
Test/Exam	**30%**
2 Test/Exams of equal value.	
Assignments	**30%**
3 Scheduled Moodle Activities, consisting of Quizzes, and Theory Assignments of equal value.	
Applied Activities (G)	**40%**
4 Scheduled Lab Evaluations of equal value.	

ADDITIONAL INFORMATION

A course outline is the College's commitment to the students. It supports educators, students, employers, and external partners in determining the depth of knowledge and level of performance that a student will be able to demonstrate upon successful completion of a course. Both instructor and student are obligated to follow the content of the course outline. It is your responsibility to meet these outcomes as assigned.

Note: You should maintain a copy of this course outline for your records. You may require this course outline if you seek transfer credits or further studies at other institutions.

Cambrian Email Addresses

All email correspondence with currently registered students must be via the students' College-issued email, as per the College's IT Acceptable Use Policy. Students must familiarize themselves with the IT Acceptable Use Policy, as it outlines the acceptable use of College information systems and technology, and mitigates risks to the College's IT infrastructure.

Bring Your Own Device (BYOD) and Apps Anywhere

Cambrian College is a BYOD institution, which means that students bring the device of their choice that meets program-specific minimum technology requirements. Program-specific minimum technology requirements can be viewed on program pages on the Cambrian College website. AppsAnywhere is an easy-to-use app store-like platform providing students with a way to access their College apps and software on demand, anywhere, anytime both on and off campus. These both enrich the student learning experience in and out of the classroom, while providing maximum flexibility.

Policies

It is the student's responsibility to be aware of the College's policies. Policies, procedures and forms can be found on the College website.

Academic and Student Services

Cambrian has a variety of student and academic services to support students during their academic journey at the College.

- • Academic Integrity Office
- Academic Success Centre
- Bookstore and Campus Store
- International Student Support Services
- KPMG Pride Centre
- Career Centre
- Registrar's Office (Enrolment Centre)
- First Step Centre
- Accessibility Services

- Library
- Pathways
- Available Scholarships and Bursaries
- Cambrian Student Council (CSC)
- Cambrian Indigenous Student Circle (CISC)
- Cambrian Athletic Association (CAA)
- Student Life Centre
- Test Centre
- The Learning Centre [Tutoring Services]
- Wabnode Centre for Indigenous Services
- Women's Resource Centre

Copyright

Copyright is the exclusive legal right given to a creator to reproduce, publish, sell, or distribute his/her work. All members of the Cambrian community are required to comply with Canadian copyright law, which governs the reproduction, use and distribution of copyrighted materials. This means that the copying, use and distribution of copyright-protected materials, regardless of format, are subject to certain limits and restrictions. For example, activities such as photocopying or scanning an entire textbook or uploading class materials to a course sharing site are prohibited.

See the Cambrian Library website for additional information regarding copyright and for details on allowable limits.

Audio/Visual Capture

Sounds and images from this class, and contributions made by a participant, virtually or in-person, are recorded under the authority of the *Ontario Colleges of Applied Arts and Technology Act, 2002*. The main purpose of these recordings is to allow students enrolled in the course to review content and engage in activities, whether they attend any given class in person, virtually, or at all. Class recordings are for personal use only and shall not be shared or transferred. Faculty may also review these recordings to prepare for future classes, evaluate students, collaborate in program reviews, or provide feedback to faculty and/or students. Any questions about the use of multimedia recordings may be addressed to your respective Dean.

Equity, Diversity, and Inclusivity

Cambrian is committed to building and preserving an equitable, diverse, and inclusive learning community where students, faculty, and staff may achieve their full potential in an environment characterized by equality of respect and opportunity. All students and employees have the right to live and work in an environment that is free from discrimination and harassment. Therefore, Cambrian College will not tolerate any form of discrimination or harassment in its employment, education, accommodation, or business dealings. For more information, please visit: Equity, Human Rights, and Accessibility.

Prior Learning Assessment and Recognition (PLAR)

Students wishing to have work or life experience that meets course learning outcomes considered for credit through Prior Learning Assessment and Recognition should email the Enrolment Centre at records@cambriancollege.ca.

Transfer Credit

Students wishing to have courses from other programs or institutions assessed for equivalency and/or transfer credit should visit the Transfer Credits page on the Cambrian website. The student should maintain a copy of this course outline for their records. Students may require this course outline if seeking transfer credits or further studies at other institutions.

Test Proctoring at Cambrian

Many courses include major tests and/or final exams. The practice at Cambrian requires that these types of test situations involve proctoring to ensure academic integrity. Online tests/exams may employ a proctoring services to enable you to take your exam from a location of your choosing within a period specified by your instructor. When you are taking an online test/exam, the proctoring service may capture your video, screen, audio, and web surfing data to protect academic integrity. Cambrian College collects, uses, discloses, and retains personal information in compliance with the *Freedom of Information and Protection of Privacy Act (FIPPA)*. Your personal information is being collected under the authority of the *Ontario Colleges of Applied Arts and Technology Act S.O. 2002, c.8, Sched. F*. This information will be used for the purpose of administering a test/exam through an online proctoring service acting as an authorized agent of the College. Please refer to Cambrian's Official Student Records Policy for more details. If you have any questions regarding the collection of your personal information, please contact Vice President Academic, Cambrian College, 1400 Barry Downe Rd., Sudbury ON P3A 3V8, 1-705-566-8101 ext. 6245.

Schools of Skilled Training, Engineering Technology & Environmental Studies Regulations

Lab Attendance

This course includes a mandatory lab component. The grading in this course will include the evaluation of lab reports and performance during labs.

Cambrian College

Schools of Skilled Training, Engineering Technology & Environmental Studies
Course Outline

We acknowledge and respect that we are gathered on the traditional lands of the Anishnaabe People of Turtle Island and proudly recognize our local host Atikameksheng Anishnawbek. We also recognize the contributions of Wahnapitae First Nation and the Metis Nation of Ontario.

Course Title	Fluid Power Systems I				
Course Code:	HDA1182	Credit Value:	2	Credit Hours:	28
Programs:	HEDC Commercial Vehcile & Heavy Equipment - Dual Credit HTAP Heavy Equipment Techniques				
Equivalencies		Prerequisites		Corequisites	GOM1142

This course may be delivered in a variety of different formats: 100% in-class, 100% online (or a blend of both), videoconferencing, distributed learning or off-campus. Please confirm with your faculty member which format will be used for your section of this course.

General Education Course:	☐	Eligible for PLAR:	☑
Degree Breadth Course:	☐	Experiential Learning:	☐
Research Intensive Course Designation:	☐		

COURSE DESCRIPTION

In this course, students will interpret schematics and perform pressure, force, and area calculations related to hydraulics. They will describe the service procedures of hydraulic fluids, reservoirs, and conditioners following manufacturers' recommendations. Students will be able to replace hydraulic lines and fittings as well as recommend repairs to hydraulic control valves. Finally, they will be able to recommend repairs to hydraulic pumps following manufacturers' recommendations.

Date: June 11, 2026

Approved by:

ANGELA GILMORE
Chair, Schools Of Skilled Training, Engineering Technology & Environmental Studies

Effective: Fall 2026, Winter 2027, Spring 2027

RELATIONSHIP TO PROGRAM VOCATIONAL LEARNING OUTCOMES

PROGRAM LEVEL	
This course contributes to your program by allowing you to demonstrate the following vocational learning outcomes:	
Program(s)	**Vocational Learning Outcomes**
Commercial Vehcile & Heavy Equipment - Dual Credit	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Disassemble and assemble heavy duty equipment components to required specifications. 3. Inspect and test basic heavy duty equipment systems and subsystems using basic knowledge of hydraulics and pneumatics. 4. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 5. Prepare logs, records, and documentation to appropriate standards. 6. Apply communication skills to improve customer service. 7. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.
Heavy Equipment Techniques - Apprenticeship	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Disassemble and assemble heavy duty equipment components to required specifications. 3. Inspect and test basic heavy duty equipment systems and subsystems using basic knowledge of hydraulics and pneumatics. 4. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 5. Prepare logs, records, and documentation to appropriate standards. 6. Apply communication skills to improve customer service. 7. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.

COURSE CURRICULUM

Topics/Concepts Covered in This Course

- Fluid Power Fundamentals
- Fluid Power Component and Graphic Symbols
- Fluid Power Principles of Operation
- Fluid Power Hydraulic Fluid and Filters
- Fluid Power Conductors and Connectors
- Fluid Power Maintenance Schedule

COURSE LEVEL: Learning Outcomes and Objectives

To earn credit for this course, you must reliably demonstrate your ability to:

Learning Outcome	Objectives	Competency Profile
1. Perform basic calculations of pressure, force, and area using Imperial and système international d'unités (s.i.) measurement.	1.1 Explain the fundamentals of hydraulic and pneumatic systems. - basic laws and their applications • Pascal's Law • Boyle's Law • Charles's Law • Gay-Lussac's Law • Bernoulli's Principle 1.2 Describe hydraulic and pneumatic terms and applications. - - basic terms • hydrostatics • hydrodynamics • positive and negative pressures basic applications of hydraulics and pneumatics • fluid power leverage 1.3 Perform calculations for: - pressure, force, and area • Imperial • système international d'unités (s.i.)	S1242.1
2. Lnterpret basic hydraulic and pneumatic systems following manufacturers' recommendations and schematics.	2.1 Identify the components and graphic symbols. - basic components • reservoir (filters and lines) • pumps and compressors • valves (pressure, volume and directional control) • actuators (rotary and linear)	S1242.2

Learning Outcome	Objectives	Competency Profile
	2.2 Describe the features, composition, types, and application of schematics for pneumatic and hydraulic systems. - - - pneumatic schematics and graphic symbols - hydraulic schematics and graphic symbols • explain and interpret manufacturer's schematic legends 2.3 Perform basic circuit drawing using graphic symbols. - - - hydraulic circuits - pneumatic circuit - safety precautions • pressure escape and containment • eye, hearing and skin protection • control of hazardous materials • ventilation of work areas • lifting/hoisting procedures • fire hazard prevention • high pressure fluid injection/ penetration to skin • supporting and blocking hydraulic components - communications • information accessing • practical reporting • technical service bulletins • data management systems - service records - microfiche - service information systems - electronic format • current legislated requirements • WHMIS - mathematics • système international d'unités (s.i.) to Imperial conversion	

Learning Outcome	Objectives	Competency Profile
3. Explain the operation of basic hydraulic and pneumatic components following manufacturers' recommendations.	3.1 Explain the fundamental of pneumatic and hydraulic components. - - - - - pumps and compressors • gear • vane • piston - valves • pressure relief valve • directional control valve • volume control valve - actuators • linear • rotary = reservoirs and receivers • vented and pressurized 3.2 Identify the construction features, types, and styles of pneumatic and hydraulic components. - - - - - pumps and compressors • gear • vane • piston - valves • pressure relief valve • directional control valve • volume control valve - actuators • linear • rotary - reservoirs and receivers • vented and pressurized 3.3 Describe the principles of operation of pneumatic and hydraulic components. - - - - - pumps and compressors • gear • vane • piston - valves • pressure relief valve • directional control valve • volume control valve - actuators • linear • rotary - reservoirs and receivers • vented and pressurized	S1242.3

Learning Outcome	Objectives	Competency Profile
	3.4 Identify and locate hydraulic and pneumatic components on basic systems. - - - pneumatic components using schematics - hydraulic components using schematics -	
4. Describe the different types of hydraulic fluid and their application following manufacturers' recommendations.	4.1 Explain the purpose and fundamentals of hydraulic fluids. -- - power transfer medium - lubrication - cooling 4.2 Identify the composition and properties of hydraulic fluids. ---- - viscosity - fire supporting • volatility • flammability - fire retard - synthetic 4.3 Describe the function and construction features of hydraulic fluid filters. ------ - basic filtration - media types • surface types • depth types - beta ratio - micron rating - delta pressure - full-flow - by-pass	S1242.4
5. Describe the inspection and testing procedures for hydraulic and pneumatic conductors and fittings following manufacturers' recommendations.	5.1 Explain the purpose of pneumatic and hydraulic conductors and connectors. - - - lines -pipes and tubing - fittings 5.2 Identify the construction features, types, and application of conductors and connectors. - pneumatic lines and hoses - hydraulic lines and hoses - pneumatic fittings - hydraulic fittings • standard, British and metric fitting	S1242.5

Learning Outcome	Objectives	Competency Profile
	5.3 Demonstrate the fabrication, inspection, and testing procedures following manufacturers' recommendations for pneumatic and hydraulic conductors and connectors. - - - - hydraulic hose fabrication identify hazards related to line replacement - • identify the risks of fluid injection into the skin - outline the inspection procedure for hydraulic conductors and connectors • always use a mechanical device to move hydraulic lines when looking for leaks	
6. Describe a regularly scheduled maintenance service following manufacturers' recommendations for hydraulic and pneumatic systems.	6.1 Explain the fundamentals of regular hydraulic and pneumatic system maintenance service. - - - - - - - - maintenance schedules - oil sampling - fluid servicing - filter servicing - reservoir servicing - inspection - troubleshooting common defects 6.2 Demonstrate maintenance procedures following manufacturers' recommendations for pneumatic and hydraulic systems. - - - - - - - procedure to service filters - oil sampling procedures - identify oil contamination - hydraulic and pneumatic line inspection - water separator inspection - perform a maintenance schedule c	S1242.6

Essential Employability Skills

Communication
- communicate clearly in written, spoken, and visual form that fulfills purpose/ needs of audience.
- respond to written, spoken, or visual messages in a manner that ensures effective communication.

Numeracy
- execute mathematical operations accurately.

Critical Thinking and Problem Solving
- apply a systematic approach to solve problems.
- use a variety of thinking skills to anticipate and solve problems.

Information Management
- locate, select, organize, and document information using appropriate technology and info systems.
- analyze, evaluate, and apply relevant information from a variety of sources.

Interpersonal
- show respect for the diverse opinions, values, belief systems, and contributions of others.
- interact with others in groups in ways that contribute to effective working relationships.

Personal
- manage the use of time and other resources to complete projects.
- take responsibility for one's own actions, decisions, and consequences.

Delivery Method
- Classroom: Course is delivered through scheduled synchronous teaching that may be face-to-face and/or virtual.

Learning Activities
- Lectures
- Class Discussions
- Labs
- Group Work
- Research
- Self-Directed Learning
- Scenario Testing
- Physical Activity
- In-Class Exercises
- Small Group Instruction
- One-to-One Instruction
- eLearning Components

Resources Required

Additional Supplies

Coveralls
Fire Resistant, one piece
Estimated Cost: 150

Safety Boots
CSA approved, 8" high, steel toe
Estimated Cost: 150

Safety Glasses
CSA approved, with clear lenses
Estimated Cost: 50

Text Resource
Cengage - Heavy Equipment Systems 4th edition Online purchase, contact your professor
Estimated Cost: 200

Laptop
Capable of running excel, word, paint, and access the internet
Estimated Cost: 1500

Evaluation Plan

Grading Scheme

A	80%	-	100%
B	70%	-	79%
F	0%	-	69%

Evaluation Method	Value (%)
Test/Exam	**40%**
2 tests of equal value, totaling 40%	
Quizzes	**40%**
3 quizzes/exercises of equal value, totaling 40%	
Applied Activities (G)	**20%**
3 Lab Evaluations of equal value, totaling 20%	

ADDITIONAL INFORMATION

A course outline is the College's commitment to the students. It supports educators, students, employers, and external partners in determining the depth of knowledge and level of performance that a student will be able to demonstrate upon successful completion of a course. Both instructor and student are obligated to follow the content of the course outline. It is your responsibility to meet these outcomes as assigned.

Note: You should maintain a copy of this course outline for your records. You may require this course outline if you seek transfer credits or further studies at other institutions.

Cambrian Email Addresses

All email correspondence with currently registered students must be via the students' College-issued email, as per the College's IT Acceptable Use Policy. Students must familiarize themselves with the IT Acceptable Use Policy, as it outlines the acceptable use of College information systems and technology, and mitigates risks to the College's IT infrastructure.

Bring Your Own Device (BYOD) and Apps Anywhere

Cambrian College is a BYOD institution, which means that students bring the device of their choice that meets program-specific minimum technology requirements. Program-specific minimum technology requirements can be viewed on program pages on the Cambrian College website. AppsAnywhere is an easy-to-use app store-like platform providing students with a way to access their College apps and software on demand, anywhere, anytime both on and off campus. These both enrich the student learning experience in and out of the classroom, while providing maximum flexibility.

Policies

It is the student's responsibility to be aware of the College's policies. Policies, procedures and forms can be found on the College website.

Academic and Student Services

Cambrian has a variety of student and academic services to support students during their academic journey at the College.

- • Academic Integrity Office
- Academic Success Centre
- Bookstore and Campus Store
- International Student Support Services
- KPMG Pride Centre
- Career Centre
- Registrar's Office (Enrolment Centre)
- First Step Centre
- Accessibility Services
- Library
- Pathways
- Available Scholarships and Bursaries
- Cambrian Student Council (CSC)
- Cambrian Indigenous Student Circle (CISC)
- Cambrian Athletic Association (CAA)
- Student Life Centre
- Test Centre
- The Learning Centre [Tutoring Services]
- Wabnode Centre for Indigenous Services
- Women's Resource Centre

Copyright

Copyright is the exclusive legal right given to a creator to reproduce, publish, sell, or distribute his/her work. All members of the Cambrian community are required to comply with Canadian copyright law, which governs the reproduction, use and distribution of copyrighted materials. This means that the copying, use and distribution of copyright-protected materials, regardless of format, are subject to certain limits and restrictions. For example, activities such as photocopying or scanning an entire textbook or uploading class materials to a course sharing site are prohibited.

See the Cambrian Library website for additional information regarding copyright and for details on allowable limits.

Audio/Visual Capture

Sounds and images from this class, and contributions made by a participant, virtually or in-person, are recorded under the authority of the *Ontario Colleges of Applied Arts and Technology Act, 2002*. The main purpose of these recordings is to allow students enrolled in the course to review content and engage in activities, whether they attend any given class in person, virtually, or at all. Class recordings are for personal use only and shall not be shared or transferred. Faculty may also review these recordings to prepare for future classes, evaluate students, collaborate in program reviews, or provide feedback to faculty and/or students. Any questions about the use of multimedia recordings may be addressed to your respective Dean.

Equity, Diversity, and Inclusivity

Cambrian is committed to building and preserving an equitable, diverse, and inclusive learning community where students, faculty, and staff may achieve their full potential in an environment characterized by equality of respect and opportunity. All students and employees have the right to live and work in an environment that is free from discrimination and harassment. Therefore, Cambrian College will not tolerate any form of discrimination or harassment in its employment, education, accommodation, or business dealings. For more information, please visit: Equity, Human Rights, and Accessibility.

Prior Learning Assessment and Recognition (PLAR)

Students wishing to have work or life experience that meets course learning outcomes considered for credit through Prior Learning Assessment and Recognition should email the Enrolment Centre at records@cambriancollege.ca.

Transfer Credit

Students wishing to have courses from other programs or institutions assessed for equivalency and/or transfer credit should visit the Transfer Credits page on the Cambrian website. The student should maintain a copy of this course outline for their records. Students may require this course outline if seeking transfer credits or further studies at other institutions.

Test Proctoring at Cambrian

Many courses include major tests and/or final exams. The practice at Cambrian requires that these types of test situations involve proctoring to ensure academic integrity. Online tests/exams may employ a proctoring services to enable you to take your exam from a location of your choosing within a period specified by your instructor. When you are taking an online test/exam, the proctoring service may capture your video, screen, audio, and web surfing data to protect academic integrity. Cambrian College collects, uses, discloses, and retains personal information in compliance with the *Freedom of Information and Protection of Privacy Act (FIPPA)*. Your personal information is being collected under the authority of the *Ontario Colleges of Applied Arts and Technology Act S.O. 2002, c.8, Sched. F*. This information will be used for the purpose of administering a test/exam through an online proctoring service acting as an authorized agent of the College. Please refer to Cambrian's Official Student Records Policy for more details. If you have any questions regarding the collection of your personal information, please contact Vice President Academic, Cambrian College, 1400 Barry Downe Rd., Sudbury ON P3A 3V8, 1-705-566-8101 ext. 6245.

Schools of Skilled Training, Engineering Technology & Environmental Studies Regulations

Lab Attendance

This course includes a mandatory lab component. The grading in this course will include the evaluation of lab reports and performance during labs.

Cambrian College

Schools of Skilled Training, Engineering Technology & Environmental Studies
Course Outline

We acknowledge and respect that we are gathered on the traditional lands of the Anishnaabe People of Turtle Island and proudly recognize our local host Atikameksheng Anishnawbek. We also recognize the contributions of Wahnapitae First Nation and the Metis Nation of Ontario.

Course Title	Electrical Systems I				
Course Code:	HDA1183	Credit Value:	3	Credit Hours:	42
Programs:	HEDC Commercial Vehcile & Heavy Equipment - Dual Credit HTAP Heavy Equipment Techniques				
Equivalencies		Prerequisites		Corequisites	GOM1142

This course may be delivered in a variety of different formats: 100% in-class, 100% online (or a blend of both), videoconferencing, distributed learning or off-campus. Please confirm with your faculty member which format will be used for your section of this course.

General Education Course:	☐	Eligible for PLAR:	☑
Degree Breadth Course:	☐	Experiential Learning:	☐
Research Intensive Course Designation:	☐		

COURSE DESCRIPTION

In this course, students will be able to describe the principles of electricity following accepted scientific theories. They will describe the laws governing electricity and the use of basic electrical test equipment following manufacturers' recommendations. The students will also trace, test, and repair electrical circuits, as well as locate and test circuits and components. Finally, they will diagnose and repair electrical circuits and describe the operation of electromagnetic devices as well as test and evaluate batteries.

Date: June 11, 2026

Approved by:

ANGELA GILMORE
Chair, Schools Of Skilled Training, Engineering Technology & Environmental Studies

Effective: Fall 2026, Winter 2027, Spring 2027

RELATIONSHIP TO PROGRAM VOCATIONAL LEARNING OUTCOMES

PROGRAM LEVEL	
This course contributes to your program by allowing you to demonstrate the following vocational learning outcomes:	
Program(s)	**Vocational Learning Outcomes**
Commercial Vehcile & Heavy Equipment - Dual Credit	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Identify, inspect, and test basic heavy duty equipment electrical and electronic components and systems in compliance with manufacturers' recommendations. 3. Disassemble and assemble heavy duty equipment components to required specifications. 4. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 5. Prepare logs, records, and documentation to appropriate standards. 6. Apply communication skills to improve customer service. 7. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.
Heavy Equipment Techniques - Apprenticeship	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Identify, inspect, and test basic heavy duty equipment electrical and electronic components and systems in compliance with manufacturers' recommendations. 3. Disassemble and assemble heavy duty equipment components to required specifications. 4. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 5. Prepare logs, records, and documentation to appropriate standards. 6. Apply communication skills to improve customer service.

COURSE CURRICULUM

Topics/Concepts Covered in This Course

- S1244.1 Introduction to Electricity
- S1244.2 Laws Governing Electricity
- S1244.3 Basic Electrical Test Equipment
- S1244.4 Electrical Circuits and Calculations
- S1244.5 Electrical Circuit and Protection Devices
- S1244.6 Electrical Circuit Repair
- S1244.7 Electromagnetic Devices
- S1244.8 Battery Fundamentals

COURSE LEVEL: Learning Outcomes and Objectives		
To earn credit for this course, you must reliably demonstrate your ability to:		
Learning Outcome	**Objectives**	**Competency Profile**
1. Describe the principles of electricity following accepted scientific theories.	1.1 Explain the purpose, fundamentals, and principles of electricity. - - - - - atomic structure - conductors and insulators - electron and conventional theories - sources of electricity • heat • pressure • friction • chemical • light • magnetism	S1244.1

Learning Outcome	Objectives	Competency Profile
2. Describe the laws governing electricity.	2.1 Explain the fundamentals of electrical laws. - Ohm's Law • state law • mathematical relationship between current, voltage, and resistance - Watt's Law • state law • mathematical relationship between current, voltage, and wattage - Kirchhoff's Laws • state laws o current law o voltage law • mathematical relationship of individual voltage drops to circuit voltage	S1244.2
3. Explain the fundamentals and purpose of and demonstrate use of electrical test equipment.	3.1 Explain the fundamentals and purpose of the following electrical tools: - analog and digital instruments - voltmeter - ammeter - ohmmeter - electronic service tools (EST) - message identifiers (MIDs) - parameters identifiers (PIDs) - subsystem identifiers (SIDs) - fault mode indicators (FIMs) - communication protocol J1939 and J1587/1708 - test lamp 3.2 Demonstrate the use of the following electrical tools: - analog and digital instruments - voltmeter - ammeter - ohmmeter - electronic service tools (EST) - message identifiers (MIDs) - parameters identifiers (PIDs) - subsystem identifiers (SIDs) - fault mode indicators (FIMs) - communication protocol J1939 and J1587/1708 - test lamp	S1244.3

Learning Outcome	Objectives	Competency Profile
4. Test, and repair electrical circuits following manufacturers' recommendations.	4.1 Explain the fundamentals of electrical circuits. - - - define the following terms: • voltage • amperage • resistance • wattage • grounds • power source - circuit related electrical fundame 4.2 Identify the construction features, composition, types, and application of electrical circuits. - electrical schematics and symbols - electrical circuit formulae - series, parallel, and series-parallel circuits - circuit characteristics 4.3 Perform circuit calculations to verify Ohm's and Kirchoff's Laws. - - apply Ohm's law to the following: • series, parallel, and series-parallel circuits • circuit calculations 4.4 Perform circuit calculations to verify Ohm's and Kirchoff's Laws for: - series, parallel, and series-parallel circuits - circuit calculations	S1244.4
5. Locate and test circuits and components following manufacturers' schematics and specifications.	5.1 Explain the purpose and function of vehicle electrical circuit schematics and protection devices. - schematics - symbol - fuses/breakers/fusible links -virtual fuses/breakers (current protected drivers) - circuit identification	S1244.5

Learning Outcome	Objectives	Competency Profile
	5.2 Identify the construction features, type, style, and application of wiring diagrams for: - wiring schematics - line type - valley forge type - illustrated - Deutsche International (DIN) - electrical symbols - protection devices - circuit breakers - fuses - virtual fuses/breakers (current protected drivers) - fusible links - wiring and connectors - wire size configuration - American Wire Gauge (AWG)/ système international d'unités (s.i.) - identification - composition - terminal configuration (multi-pin, layout) 5.3 Perform component location and condition assessment exercise following manufacturers' recommendations for: - pin-out test - component function test (switches, ect.) - identify component location using equipment schematics	
6. Diagnose and repair electrical circuits following manufacturers' recommendations.	6.1 Explain electrical circuit failures for: - opens - shorts - unintentional grounds - high resistance conditions 6.2 Identify the characteristics of electrical circuit failures for: - opens - shorts - unintentional grounds - high resistance conditions	S1244.6

Learning Outcome	Objectives	Competency Profile
	6.3 Describe the construction, types, styles, and application of the following electrical circuit connectors: - Weatherpack-Deutsch - soldered and solderless joints - heat shrink tubing - connectors - corrosive protection materials 6.4 Perform reconditioning or repair procedures following manufacturers' recommendations for the following electrical circuit repairs: - proprietary connectors/tools (e.g. Weatherpack-Deutsch) - soldered and solderless joints - heat shrink tubing - identification corrosive protection materials	
7. Describe the operation of electromagnetic devices following manufacturers' recommendations.	7.1 Explain the fundamentals of electromagnetic device operation for: - magnetism - electromagnetism - current flow and magnetic principles for relays, solenoids, and motors - right and left hand rules - counter electromotive force effects 7.2 Identify the construction, types, and application for the following electromagnetic devices: - electric motors - solenoids - relays - generators - coils - stepper motors	S1244.7

Learning Outcome	Objectives	Competency Profile
	7.3 Describe the principles of operation of the following electromagnetic devices: - motors - torque and power - solenoids - relays - coils - generators - stepper motors	
8. Service, test and evaluate batteries following manufacturers' recommendations.	8.1 Explain the following battery terminology: - reserve capacity - cold cranking rating - temperature effects - internal resistance - electrolyte characteristics 8.2 Identify the types, styles, and application of the following battery types: - flooded cell (e.g. lead acid) - low maintenance - gel cell batteries - absorbed glass mat (AGM) 8.3 Describe the principles of operation of charging and discharging of batteries for: - chemical action - temperature/internal resistance effects - charge/discharge cycle (constant voltage/current) 8.4 Perform inspection and testing procedures following manufacturers' recommendations for batteries for: - visual inspection - state of charge - surface discharge - load test - high rate discharge test - refractometer test - impedance test - safe handling	S1244.8

Learning Outcome	Objectives	Competency Profile
	8.5 Recommend reconditioning or repairs following manufacturers' recommendations to batteries for: - storage - activation - cleaning - charging - removal and replacement procedures - safe handling	

Essential Employability Skills

Communication
- communicate clearly in written, spoken, and visual form that fulfills purpose/ needs of audience.
- respond to written, spoken, or visual messages in a manner that ensures effective communication.

Numeracy
- execute mathematical operations accurately.

Critical Thinking and Problem Solving
- apply a systematic approach to solve problems.
- use a variety of thinking skills to anticipate and solve problems.

Information Management
- locate, select, organize, and document information using appropriate technology and info systems.
- analyze, evaluate, and apply relevant information from a variety of sources.

Interpersonal
- show respect for the diverse opinions, values, belief systems, and contributions of others.
- interact with others in groups in ways that contribute to effective working relationships.

Personal
- manage the use of time and other resources to complete projects.
- take responsibility for one's own actions, decisions, and consequences.

Delivery Method
- Classroom: Course is delivered through scheduled synchronous teaching that may be face-to-face and/or virtual.

Learning Activities

- Lectures
- Class Discussions
- Labs
- Group Work
- Research
- Self-Directed Learning
- Scenario Testing
- Physical Activity
- In-Class Exercises
- Small Group Instruction
- One-to-One Instruction
- eLearning Components

Resources Required

Additional Supplies

Coveralls
Fire Resistant one piece coveralls
Estimated Cost: 150

Laptop
Capable of running excel, word, paint and internet
Estimated Cost: 1500

CDX Fundamentals of Mobile Heavy Equipment
Estimated Cost: 200

Safety Glasses
CSA approved, with clear lenses
Estimated Cost: 50

Cengage Heavy Equipment Systems 4th Edition
Estimated Cost: 200

Safety Boots
CSA approved, 8" high steel toe
Estimated Cost: 200

Evaluation Plan

Grading Scheme

A	80%	-	100%
B	70%	-	79%
F	0%	-	69%

Evaluation Method	Value (%)
Test/Exam	**30%**
2 Test/Exams of equal value.	

Evaluation Method	Value (%)
Quizzes	**30%**
3 Scheduled Moodle Activities, consisting of Quizzes, and Theory Assignments of equal value.	
Applied Activities (G)	**40%**
4 Scheduled Lab Evaluations of equal value	

ADDITIONAL INFORMATION

A course outline is the College's commitment to the students. It supports educators, students, employers, and external partners in determining the depth of knowledge and level of performance that a student will be able to demonstrate upon successful completion of a course. Both instructor and student are obligated to follow the content of the course outline. It is your responsibility to meet these outcomes as assigned.

Note: You should maintain a copy of this course outline for your records. You may require this course outline if you seek transfer credits or further studies at other institutions.

Cambrian Email Addresses

All email correspondence with currently registered students must be via the students' College-issued email, as per the College's IT Acceptable Use Policy. Students must familiarize themselves with the IT Acceptable Use Policy, as it outlines the acceptable use of College information systems and technology, and mitigates risks to the College's IT infrastructure.

Bring Your Own Device (BYOD) and Apps Anywhere

Cambrian College is a BYOD institution, which means that students bring the device of their choice that meets program-specific minimum technology requirements. Program-specific minimum technology requirements can be viewed on program pages on the Cambrian College website. AppsAnywhere is an easy-to-use app store-like platform providing students with a way to access their College apps and software on demand, anywhere, anytime both on and off campus. These both enrich the student learning experience in and out of the classroom, while providing maximum flexibility.

Policies

It is the student's responsibility to be aware of the College's policies. Policies, procedures and forms can be found on the College website.

Academic and Student Services

Cambrian has a variety of student and academic services to support students during their academic journey at the College.

- • Academic Integrity Office
- Academic Success Centre
- Bookstore and Campus Store
- International Student Support Services
- KPMG Pride Centre
- Career Centre
- Registrar's Office (Enrolment Centre)
- First Step Centre
- Accessibility Services
- Library
- Pathways
- Available Scholarships and Bursaries

- Cambrian Student Council (CSC)
- Cambrian Indigenous Student Circle (CISC)
- Cambrian Athletic Association (CAA)
- Student Life Centre
- Test Centre
- The Learning Centre [Tutoring Services]
- Wabnode Centre for Indigenous Services
- Women's Resource Centre

Copyright

Copyright is the exclusive legal right given to a creator to reproduce, publish, sell, or distribute his/her work. All members of the Cambrian community are required to comply with Canadian copyright law, which governs the reproduction, use and distribution of copyrighted materials. This means that the copying, use and distribution of copyright-protected materials, regardless of format, are subject to certain limits and restrictions. For example, activities such as photocopying or scanning an entire textbook or uploading class materials to a course sharing site are prohibited.

See the Cambrian Library website for additional information regarding copyright and for details on allowable limits.

Audio/Visual Capture

Sounds and images from this class, and contributions made by a participant, virtually or in-person, are recorded under the authority of the *Ontario Colleges of Applied Arts and Technology Act, 2002*. The main purpose of these recordings is to allow students enrolled in the course to review content and engage in activities, whether they attend any given class in person, virtually, or at all. Class recordings are for personal use only and shall not be shared or transferred. Faculty may also review these recordings to prepare for future classes, evaluate students, collaborate in program reviews, or provide feedback to faculty and/or students. Any questions about the use of multimedia recordings may be addressed to your respective Dean.

Equity, Diversity, and Inclusivity

Cambrian is committed to building and preserving an equitable, diverse, and inclusive learning community where students, faculty, and staff may achieve their full potential in an environment characterized by equality of respect and opportunity. All students and employees have the right to live and work in an environment that is free from discrimination and harassment. Therefore, Cambrian College will not tolerate any form of discrimination or harassment in its employment, education, accommodation, or business dealings. For more information, please visit: Equity, Human Rights, and Accessibility.

Prior Learning Assessment and Recognition (PLAR)

Students wishing to have work or life experience that meets course learning outcomes considered for credit through Prior Learning Assessment and Recognition should email the Enrolment Centre at records@cambriancollege.ca.

Transfer Credit

Students wishing to have courses from other programs or institutions assessed for equivalency and/or transfer credit should visit the Transfer Credits page on the Cambrian website. The student should maintain a copy of this course outline for their records. Students may require this course outline if seeking transfer credits or further studies at other institutions.

Test Proctoring at Cambrian

Many courses include major tests and/or final exams. The practice at Cambrian requires that these types of test situations involve proctoring to ensure academic integrity. Online tests/exams may employ a proctoring services to enable you to take your exam from a location of your choosing

within a period specified by your instructor. When you are taking an online test/exam, the proctoring service may capture your video, screen, audio, and web surfing data to protect academic integrity. Cambrian College collects, uses, discloses, and retains personal information in compliance with the *Freedom of Information and Protection of Privacy Act (FIPPA)*. Your personal information is being collected under the authority of the *Ontario Colleges of Applied Arts and Technology Act S.O. 2002, c.8, Sched. F*. This information will be used for the purpose of administering a test/exam through an online proctoring service acting as an authorized agent of the College. Please refer to Cambrian's Official Student Records Policy for more details. If you have any questions regarding the collection of your personal information, please contact Vice President Academic, Cambrian College, 1400 Barry Downe Rd., Sudbury ON P3A 3V8, 1-705-566-8101 ext. 6245.

Cambrian College

Schools of Skilled Training, Engineering Technology & Environmental Studies
Course Outline

We acknowledge and respect that we are gathered on the traditional lands of the Anishnaabe People of Turtle Island and proudly recognize our local host Atikameksheng Anishnawbek. We also recognize the contributions of Wahnapitae First Nation and the Metis Nation of Ontario.

Course Title	Fuel Systems I				
Course Code:	HDA1184	Credit Value:	2	Credit Hours:	28
Programs:	HEDC Commercial Vehcile & Heavy Equipment - Dual Credit HTAP Heavy Equipment Techniques				
Equivalencies		Prerequisites		Corequisites	GOM1142

This course may be delivered in a variety of different formats: 100% in-class, 100% online (or a blend of both), videoconferencing, distributed learning or off-campus. Please confirm with your faculty member which format will be used for your section of this course.

General Education Course:	☐	Eligible for PLAR:	☑
Degree Breadth Course:	☐	Experiential Learning:	☐
Research Intensive Course Designation:	☐		

COURSE DESCRIPTION

In this course, students will be able to describe the fundamentals of diesel fuel as well as inspect engine fuel
systems following manufacturers' recommendations. They will also be able to recommend repairs to diesel fuel
sub-systems and recommend repairs to diesel fuel injectors.

Date: June 11, 2026

Approved by:

ANGELA GILMORE
Chair, Schools Of Skilled Training, Engineering Technology & Environmental Studies

Effective: Fall 2026, Winter 2027, Spring 2027

RELATIONSHIP TO PROGRAM VOCATIONAL LEARNING OUTCOMES

PROGRAM LEVEL	
This course contributes to your program by allowing you to demonstrate the following vocational learning outcomes:	
Program(s)	**Vocational Learning Outcomes**
Commercial Vehcile & Heavy Equipment - Dual Credit	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Identify, inspect, and test basic heavy duty equipment engine components and systems in compliance with manufacturers' recommendations. 3. Disassemble and assemble heavy duty equipment components to required specifications. 4. Use a variety of test equipment and schematics to assess basic heavy duty equipment fuel systems and subsystems. 5. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 6. Prepare logs, records, and documentation to appropriate standards. 7. Apply communication skills to improve customer service. 8. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.
Heavy Equipment Techniques - Apprenticeship	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Identify, inspect, and test basic heavy duty equipment engine components and systems in compliance with manufacturers' recommendations. 3. Disassemble and assemble heavy duty equipment components to required specifications. 4. Use a variety of test equipment and schematics to assess basic heavy duty equipment fuel systems and subsystems. 5. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 6. Prepare logs, records, and documentation to appropriate standards. 7. Apply communication skills to improve customer service.

Program(s)	Vocational Learning Outcomes
	8. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.

COURSE CURRICULUM

Topics/Concepts Covered in This Course

- S1245.1 Fundamentals of Diesel Fuel System
- 1245.2 Diesel Fuel Injection Principles
- 1245.3 Diesel Fuel Injection Sub-Systems
- 1245.4 Diesel Hydraulic Injectors

COURSE LEVEL: Learning Outcomes and Objectives		
To earn credit for this course, you must reliably demonstrate your ability to:		
Learning Outcome	**Objectives**	**Competency Profile**
1. 1. Describe the fundamentals of diesel fuel following manufacturers' recommendation	1.1 1.1 Explain the purpose and fundamentals of diesel fuels. - engine theory - thermodynamics - heat energy/calorific value - combustion ratios - fuel chemistry 1.2 Identify the functions, composition, and properties of fuels. - diesel fuel - volatility - cetane number - viscosity - additives - sulphur content - gasoline - octane ratings - additives - compressed natural gas - propane - alternative fuels - bio-die 1.3 Describe the combustion principles of diesel fuels. - oxidation reactions - products of combustion - air/fuel ratios	S1245.1

Learning Outcome	Objectives	Competency Profile
2. Inspect engine fuel systems following manufacturers' recommendations.	2.1 2.1 Explain the purpose and fundamentals of fuel systems. - hydraulics - engine operating principles - the Diesel and Otto cycle - cylinder combustion dynamics 2.2 Identify the functions, composition features, types, and application of fuel system components. - fuel system circuit layout - fuel sub-systems - pressure injection apparatus - combustion chamber types - indirect injection - direct injection - hydromechanical engine management - electronic engine management - identifying fuel systems by type 2.3 Describe the combustion principles of fuels. - types of low and high pressure pumps - indirect injection - direct injection - ignition timing, cylinder pressure, and crank throw mechanics 2.4 Perform inspection and testing procedures following manufacturers' recommendations for fuel systems. - identify fuel circuit components on different engines - demonstrate the external differences between mechanical and electronic engine fuel systems 2.5 Recommend reconditioning or repairs following manufacturers' recommendations for fuel systems. - identify different OEM engines and fuel systems - use OEM service information systems	S1245.2

Learning Outcome	Objectives	Competency Profile
3. Recommend repairs to diesel engine fuel sub-systems following manufacturers' recommendations.		S1245.3

Learning Outcome	Objectives	Competency Profile
	3.1 Explain the fundamentals of diesel engine emission systems. 3.1 Explain the purpose and fundamentals of diesel fuel sub-systems. - hydraulics - diesel fuel injection - the Diesel cycle 3.2 Identify the construction, composition, types, and application of diesel fuel sub-systems. - diesel fuel classification - fuel tanks - venting apparatus - pick-up tubes and sending units - primary fuel circuit and primary fuel filters - anti-siphon valves - water separators - transfer pumps - secondary (charge) fuel circuit and secondary fuel filters - fuel manifolds - fuel return circuit - leak-off pipes - fuel hose types and grades - crossover plumbing - bleeding devices - fuel heaters - water in fuel sensors (WIF) - charge pressure sensors - fuel temperature sensors - fuel coolers 3.3 Describe the principles of operation of diesel fuel subsystems. - heat exchangers - primary and secondary filters - vane, plunger and gear type pumps - pressure relief valves - vent valves - rollover check valves - coolant and electrical fuel heaters - priming fuel sub-systems	
	3.4 Perform the inspection and testing procedures following manufacturers' recommendations for diesel engine fuel sub-systems. - inspection and testing	

Learning Outcome	Objectives	Competency Profile
4. 4. Recommend repairs to hydraulic injectors following manufacturers' recommendations		S1245.4

Learning Outcome	Objectives	Competency Profile
	4.1 4.1 Explain the purpose and fundamentals of diesel engine injectors. - high pressure fuel injection - hydraulics - pressure and sectional area - requirements for combustion of liquid fuels - combustion characteristics - indirect injection - direct injection 4.2 Identify the functions, construction features, composition, types, and application of diesel engine injectors. - electro hydraulic nozzles - electronic unit injectors (EUI) - common rail - hydraulic nozzles - poppet nozzles - pintle nozzles - multi-orifii nozzles - mechanical unit injectors (MUI) - electronic unit injectors (EUI) - hydraulic electronic unit injectors (HEUI) - high pressure pipes - leak-off lines - fuel manifolds 4.3 Describe the principles of operation of diesel engine injectors. - electro hydraulic nozzles " soft opening control " solenoid actuators " piezo actuators - pintle nozzles - multi-orifii nozzles - hydraulic nozzles - mechanical unit injectors (MUI) - electronic unit injector (EUI) - hydraulic electronic unit injectors (HEUI) - nozzle flow area and pressure - atomization requirements of engine by type - nozzle differential ratio - variable control orifice nozzle principle - pressure wave reflection 4.4 Demonstrate the inspection and testing procedures following manufacturers' recommendations for diesel	

This is an important document and should be saved for future reference. It may be needed for certification, credit transfer and employment purposes.
Published: June 26, 2026

Essential Employability Skills

Communication
- communicate clearly in written, spoken, and visual form that fulfills purpose/ needs of audience.
- respond to written, spoken, or visual messages in a manner that ensures effective communication.

Numeracy
- execute mathematical operations accurately.

Critical Thinking and Problem Solving
- apply a systematic approach to solve problems.
- use a variety of thinking skills to anticipate and solve problems.

Information Management
- locate, select, organize, and document information using appropriate technology and info systems.
- analyze, evaluate, and apply relevant information from a variety of sources.

Interpersonal
- show respect for the diverse opinions, values, belief systems, and contributions of others.
- interact with others in groups in ways that contribute to effective working relationships.

Personal
- manage the use of time and other resources to complete projects.
- take responsibility for one's own actions, decisions, and consequences.

Delivery Method
- Classroom: Course is delivered through scheduled synchronous teaching that may be face-to-face and/or virtual.

Learning Activities
- Lectures
- Class Discussions
- Labs
- Group Work
- Research
- Self-Directed Learning
- Scenario Testing
- Physical Activity
- In-Class Exercises
- Small Group Instruction
- One-to-One Instruction
- eLearning Components

Resources Required

Additional Supplies

Laptop
Capable of running excel, word, paint and internet
Estimated Cost: 1500

CDX Fundamentals of Mobile Heavy Equipment
Estimated Cost: 200

Cengage Heavy Equipment Systems 4th Edition
Estimated Cost: 200

Coveralls
Fire Resistant one piece coveralls
Estimated Cost: 15

Safety Glasses
CSA approves, with clear lenses
Estimated Cost: 50

Safety Boots
CSA approved, 8" high steel toe
Estimated Cost: 200

Evaluation Plan

Grading Scheme

A	80% - 100%
B	70% - 79%
F	0% - 69%

Evaluation Method	Value (%)
Test/Exam	**35%**
2 Test/Exams of equal value	
Assignments	**40%**
4 Scheduled Moodle Activities, consisting of Quizzes, and Theory Assignments of equal value.	
Applied Activities (G)	**25%**
3 Scheduled Lab Evaluations of equal value	

ADDITIONAL INFORMATION

A course outline is the College's commitment to the students. It supports educators, students, employers, and external partners in determining the depth of knowledge and level of performance that a student will be able to demonstrate upon successful completion of a course. Both instructor and student are obligated to follow the content of the course outline. It is your responsibility to meet these outcomes as assigned.

Note: You should maintain a copy of this course outline for your records. You may require this course outline if you seek transfer credits or further studies at other institutions.

Cambrian Email Addresses

All email correspondence with currently registered students must be via the students' College-issued email, as per the College's IT Acceptable Use Policy. Students must familiarize themselves with the IT Acceptable Use Policy, as it outlines the acceptable use of College information systems and technology, and mitigates risks to the College's IT infrastructure.

Bring Your Own Device (BYOD) and Apps Anywhere

Cambrian College is a BYOD institution, which means that students bring the device of their choice that meets program-specific minimum technology requirements. Program-specific minimum technology requirements can be viewed on program pages on the Cambrian College website. AppsAnywhere is an easy-to-use app store-like platform providing students with a way to access their College apps and software on demand, anywhere, anytime both on and off campus. These both enrich the student learning experience in and out of the classroom, while providing maximum flexibility.

Policies

It is the student's responsibility to be aware of the College's policies. Policies, procedures and forms can be found on the College website.

Academic and Student Services

Cambrian has a variety of student and academic services to support students during their academic journey at the College.

- • Academic Integrity Office
- Academic Success Centre
- Bookstore and Campus Store
- International Student Support Services
- KPMG Pride Centre
- Career Centre
- Registrar's Office (Enrolment Centre)
- First Step Centre
- Accessibility Services
- Library
- Pathways
- Available Scholarships and Bursaries
- Cambrian Student Council (CSC)
- Cambrian Indigenous Student Circle (CISC)
- Cambrian Athletic Association (CAA)
- Student Life Centre
- Test Centre
- The Learning Centre [Tutoring Services]
- Wabnode Centre for Indigenous Services
- Women's Resource Centre

Copyright

Copyright is the exclusive legal right given to a creator to reproduce, publish, sell, or distribute his/her work. All members of the Cambrian community are required to comply with Canadian copyright law, which governs the reproduction, use and distribution of copyrighted materials. This means that the copying, use and distribution of copyright-protected materials, regardless of format, are subject to certain limits and restrictions. For example, activities such as photocopying or scanning an entire textbook or uploading class materials to a course sharing site are prohibited.

See the Cambrian Library website for additional information regarding copyright and for details on allowable limits.

Audio/Visual Capture

Sounds and images from this class, and contributions made by a participant, virtually or in-person, are recorded under the authority of the *Ontario Colleges of Applied Arts and Technology Act, 2002*. The main purpose of these recordings is to allow students enrolled in the course to review content and engage in activities, whether they attend any given class in person, virtually, or at all. Class recordings are for personal use only and shall not be shared or transferred. Faculty may also review these recordings to prepare for future classes, evaluate students, collaborate in program reviews, or provide feedback to faculty and/or students. Any questions about the use of multimedia recordings may be addressed to your respective Dean.

Equity, Diversity, and Inclusivity

Cambrian is committed to building and preserving an equitable, diverse, and inclusive learning community where students, faculty, and staff may achieve their full potential in an environment characterized by equality of respect and opportunity. All students and employees have the right to live and work in an environment that is free from discrimination and harassment. Therefore, Cambrian College will not tolerate any form of discrimination or harassment in its employment, education, accommodation, or business dealings. For more information, please visit: Equity, Human Rights, and Accessibility.

Prior Learning Assessment and Recognition (PLAR)

Students wishing to have work or life experience that meets course learning outcomes considered for credit through Prior Learning Assessment and Recognition should email the Enrolment Centre at records@cambriancollege.ca.

Transfer Credit

Students wishing to have courses from other programs or institutions assessed for equivalency and/or transfer credit should visit the Transfer Credits page on the Cambrian website. The student should maintain a copy of this course outline for their records. Students may require this course outline if seeking transfer credits or further studies at other institutions.

Test Proctoring at Cambrian

Many courses include major tests and/or final exams. The practice at Cambrian requires that these types of test situations involve proctoring to ensure academic integrity. Online tests/exams may employ a proctoring services to enable you to take your exam from a location of your choosing within a period specified by your instructor. When you are taking an online test/exam, the proctoring service may capture your video, screen, audio, and web surfing data to protect academic integrity. Cambrian College collects, uses, discloses, and retains personal information in compliance with the *Freedom of Information and Protection of Privacy Act (FIPPA)*. Your personal information is being collected under the authority of the *Ontario Colleges of Applied Arts and Technology Act S.O. 2002, c.8, Sched. F*. This information will be used for the purpose of administering a test/exam through an online proctoring service acting as an authorized agent of the College. Please refer to Cambrian's Official Student Records Policy for more details. If you have any questions regarding the collection of your personal information, please contact Vice President Academic, Cambrian College, 1400 Barry Downe Rd., Sudbury ON P3A 3V8, 1-705-566-8101 ext. 6245.

Cambrian College

Schools of Skilled Training, Engineering Technology & Environmental Studies
Course Outline

We acknowledge and respect that we are gathered on the traditional lands of the Anishnaabe People of Turtle Island and proudly recognize our local host Atikameksheng Anishnawbek. We also recognize the contributions of Wahnapitae First Nation and the Metis Nation of Ontario.

Course Title	Drive Train Systems I				
Course Code:	HDA1185	Credit Value:	2	Credit Hours:	28
Programs:	HEDC Commercial Vehcile & Heavy Equipment - Dual Credit HTAP Heavy Equipment Techniques				
Equivalencies		Prerequisites		Corequisites	GOM1142

This course may be delivered in a variety of different formats: 100% in-class, 100% online (or a blend of both), videoconferencing, distributed learning or off-campus. Please confirm with your faculty member which format will be used for your section of this course.

General Education Course:	☐	Eligible for PLAR:	☑
Degree Breadth Course:	☐	Experiential Learning:	☐
Research Intensive Course Designation:	☐		

COURSE DESCRIPTION

In this course, students will be able to explain the fundamentals of gearing used in drive train systems. They will also be able to recommend repairs to push-type clutch, flywheel assemblies, single countershaft manual transmissions, drive shafts, power take-off shafts, safety shields, universal joints and single reduction drive axle assemblies, following manufacturers' procedures and recommendations.

Date: June 11, 2026

Approved by:

ANGELA GILMORE
Chair, Schools Of Skilled Training, Engineering Technology & Environmental Studies

Effective: Fall 2026, Winter 2027, Spring 2027

RELATIONSHIP TO PROGRAM VOCATIONAL LEARNING OUTCOMES

PROGRAM LEVEL	
This course contributes to your program by allowing you to demonstrate the following vocational learning outcomes:	
Program(s)	**Vocational Learning Outcomes**
Commercial Vehcile & Heavy Equipment - Dual Credit	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Identify, inspect, and test basic heavy duty equipment engine components and systems in compliance with manufacturers' recommendations. 3. Identify, inspect and test basic power train components and systems in compliance with manufacturers' recommendations. 4. Identify, inspect, test and maintain basic suspension, steering, and brake components and systems in compliance with manufacturers' recommendations. 5. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 6. Prepare logs, records, and documentation to appropriate standards. 7. Apply communication skills to improve customer service. 8. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.
Heavy Equipment Techniques - Apprenticeship	**Apprenticeship Standards** 1. Identify, inspect and test basic power train components and systems in compliance with manufacturers' recommendations. 2. Identify, inspect, test and maintain basic suspension, steering, and brake components and systems in compliance with manufacturers' recommendations. 3. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 4. Prepare logs, records, and documentation to appropriate standards. 5. Apply communication skills to improve customer service. 6. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.

COURSE CURRICULUM

Topics/Concepts Covered in This Course

- S1246.1 Push-Type Clutch and Flywheel Assemblies
- S1246.2 Gearing Fundamentals
- S1246.3 Single Countershaft Manual Transmissions
- S1246.4 Drive Shafts, Power Take-Off Shafts, and Universal Joints
- S1246.5 Single Reduction Drive Axle Assemblies

COURSE LEVEL: Learning Outcomes and Objectives		
To earn credit for this course, you must reliably demonstrate your ability to:		
Learning Outcome	**Objectives**	**Competency Profile**
1. Recommend repairs to push-type clutch and flywheel assemblies following manufacturers' recommendations.	1.1 Explain the purpose and fundamentals of push-type clutches and flywheel assemblies. - clamping forces - mechanical advantage (lever and hydraulic) - static and sliding friction - coefficient of friction and heat - centrifugal force 1.2 Identify the composition, construction, types, and application of push-type clutches and flywheel assemblies. - disengagement and engagement - flywheel - pressure plate - clutch friction disc assembly - hubs - input shaft - release bearing - mechanical release mechanisms - hydraulic release mechanisms - bell/clutch housings	S1246.1

Learning Outcome	Objectives	Competency Profile
	1.3 Describe the principles of operation of push-type clutches and flywheel assemblies. - single disc clutches - double disc clutches - centrifugal clutches - clutch control systems - friction media - flywheel - pressure plate(s) - heat dissipation - coefficient of friction - wave springs - friction discs - hubs - clutch housing - clutch assembly alignment - power flow - pilot bushing/bearing 1.4 Demonstrate the inspection, testing, and diagnostic procedures following manufacturers' recommendations for push-type clutches and flywheel assemblies. - visual inspection - test clutch and control operation - check mechanical linkage - check hydraulic actuation system - diagnosing clutch condition - outlining lubrication practices 1.5 Recommend reconditioning or repairs following manufacturers' recommended procedures for push-type clutches and flywheel assemblies. - perform clutch adjustment - outline clutch assembly overhaul procedures - check clutch and housing alignment and concentricity - outline machining practices and flywheels dimensions	

Learning Outcome	Objectives	Competency Profile
2. Explain the fundamentals of gearing used on drive train systems.	2.1 Explain the purpose and fundamentals of gears and related support assemblies. - mechanical advantage - laws of levers - torque - input/output ratio speed - gear ratio - shafts, splines, and gears - lubrication 2.2 Identify the construction features, composition, types, and application of gears and related support assemblies. - clutching mechanisms - case - gears - shafts - bearings and bushings - spacers and thrust washers - seals and gaskets - shifting mechanisms 2.3 Describe the principles of operation of gears and related support assemblies. - gears - matching - timing - shafts - power flow - lubrication circuits - thrust control - bearings and bushings - sealing - shifting mechanisms	S1246.2
3. Recommend repairs to single countershaft manual transmissions following manufacturers' recommendations.	3.1 Explain the purpose and fundamentals of single counter-shaft manual transmissions. - mechanical advantage - laws of levers - torque - input/output ratio speed - gear ratio - shafts, splines, and gears - lubrication	S1246.3

Learning Outcome	Objectives	Competency Profile
	3.2 Identify the construction, composition, types, and application of single countershaft manual transmissions. - clutching mechanisms - synchronizers - case - gears - shafts - bearings and bushings - spacers and thrust washers - seals and gaskets - shifting mechanisms 3.3 Describe the principles of operation of gears and related support assemblies. - clutching mechanisms - synchronizers - gears - matching - timing - shafts - power flow - lubrication circuits - thrust control - bearings and bushings - sealing - shifting mechanisms 3.4 Perform the inspection, testing, and diagnostic procedures following manufacturers' recommendations on single counter-shaft manual transmissions. demonstrate: - visual inspection - performance testing - thrust measurement - checking fluid level and condition - verify power flow failure analysis for: - shock failures - fatigue failures - torsional failures - surface failures	

Learning Outcome	Objectives	Competency Profile
	3.5 Recommend reconditioning or repairs following manufacturers' procedures on single countershaft manual transmissions. - outline procedure for checking lubricant levels - recommended lubricant change intervals and procedures - identify lubricant types and application - outline procedure for transmission removal, disassembly, reassembly and replacement	
4. Recommend repair to drive shafts, power take-off shafts, safety shields and universal joints following manufacturers' procedures.	4.1 Explain the fundamentals of drive shafts, power take-off shafts, safety shields and universal joints. - angularity - articulation - telescoping - theory of non-uniform velocity - parallel drive line arrangements - broken-back drive line arrangements - parallelogram - working angle calculations - equal angle hitch geometry (e.g. agricultural drawn equipment) - shielding requirements - PTO (power take off) adapters 4.2 Identify the construction features, composition, types, and application of drive shafts, power take-off shafts, safety shields and universal joints. - drive shaft classification - drive shaft load ratings - drive shaft speed ratings - hanger bearings - slip splines - carden joints - trunnion - bearings - flanges and yokes - shielding requirements - PTO (power take off) adapters	S1246.4

Learning Outcome	Objectives	Competency Profile
	4.3 Describe the principles of operation of drive shafts, power take-off shafts, safety shields and universal joints. - angularity - velocity - phasing - balancing - run-out - torsional loading - vibration 4.4 Perform the inspection, testing, and diagnostic procedures following manufacturers' recommendations of drive shafts, power take-off shafts, safety shields and universal joints. demonstration of: - inspection techniques (wear/ damage) - noise analysis - evaluating drive line vibration - determining universal joint working angles failure analysis for: - torsional vibration - excessive angularity - operational overloading - seized slip-joint - shock failures - fatigue failures 4.5 Recommend reconditioning or repairs following manufacturers' procedures of drive shafts, power take-off shafts, safety shields and universal joints. demonstrate: - lubricating a universal joint and slip-spline assembly - replacing a cardan joint - replacing a centre hanger bearing assembly - measuring slip-spline wear - correcting component working angles	

Learning Outcome	Objectives	Competency Profile
5. Recommend repairs to single reduction drive axle assemblies following manufacturers' recommendations.	5.1 Explain the purpose and fundamentals of single reduction drive axle assemblies. - mechanical advantage - laws of levers - torque - input/output ratio speed - gear ratios - loading characteristics - differential action - thrust loads - power flow - bearing preloads - lubrication - engagement mechanisms 5.2 Identify the construction features, composition, types, and application of single reduction drive axle assemblies. - drive axle assembly - housings - carriers - removable - integral - drive gear sets (crown and pinion) - spiral bevel - hypoid - amboid - differential gearing - axle shafts - semi-floating - full floating	S1246.5

Learning Outcome	Objectives	Competency Profile
	5.3 Describe the principles of operation of single reduction drive axle assemblies. - drive axle assembly - carriers - removable - integral - drive gear sets (crown and pinion) - spiral - hypoid - amboid - differential gearing - axle shafts - semi-floating - full floating - lubrication - lubricants - noise and temperature analysis 5.4 Perform inspection, testing, and diagnostic procedures following manufacturers' recommendations of single reduction drive axle assemblies. - demonstrate: - lubricant level and condition checks - backlash measurement - pattern check	

Learning Outcome	Objectives	Competency Profile
	5.5 Recommend reconditioning or repairs following manufacturers' procedures of single reduction drive axle assemblies. - demonstrate: - lubricant change procedures - lubricant type and application - carrier removal, disassembly, reassembly, and replacement procedure. Procedure for adjusting: - pinion bearing preload - pinion depth - carrier bearing preload - drive gear set backlash Procedure for checking: - drive gear set contact pattern - drive gear set backlash - thrust block adjustment	

Essential Employability Skills

Communication
- communicate clearly in written, spoken, and visual form that fulfills purpose/ needs of audience.
- respond to written, spoken, or visual messages in a manner that ensures effective communication.

Numeracy
- execute mathematical operations accurately.

Critical Thinking and Problem Solving
- apply a systematic approach to solve problems.
- use a variety of thinking skills to anticipate and solve problems.

Information Management
- locate, select, organize, and document information using appropriate technology and info systems.
- analyze, evaluate, and apply relevant information from a variety of sources.

Interpersonal
- show respect for the diverse opinions, values, belief systems, and contributions of others.
- interact with others in groups in ways that contribute to effective working relationships.

Personal
- manage the use of time and other resources to complete projects.
- take responsibility for one's own actions, decisions, and consequences.

Delivery Method
- Classroom: Course is delivered through scheduled synchronous teaching that may be face-to-face and/or virtual.

Learning Activities

- Lectures
- Class Discussions
- Labs
- Group Work
- Self-Directed Learning
- Physical Activity
- In-Class Exercises
- Small Group Instruction
- One-to-One Instruction
- eLearning Components

Resources Required

Additional Supplies

Coveralls
Fire Resistant one piece coveralls
Estimated Cost: 150

Laptop
Capable of running excel, word, paint and internet
Estimated Cost: 1500

CDX Fundamentals of Mobile Heavy Equipment
Estimated Cost: 200

Cengage Heavy Equipment Systems 4th Edition
Estimated Cost: 200

Safety Glasses
CSA approves, with clear lenses
Estimated Cost: 50

Safety Boots
CSA approved, 8" high steel toe
Estimated Cost: 200

Evaluation Plan

Grading Scheme

A	80%	-	100%
B	70%	-	79%
F	0%	-	69%

Evaluation Method	Value (%)
Test/Exam	**35%**
2 Test/Exams of equal value	
Quizzes	**40%**
4 Scheduled Moodle Activities, consisting of Quizzes, and Theory Assignments of equal value.	

Evaluation Method	Value (%)
Applied Activities (G)	**25%**
3 Scheduled Lab Evaluations of equal value	

ADDITIONAL INFORMATION

A course outline is the College's commitment to the students. It supports educators, students, employers, and external partners in determining the depth of knowledge and level of performance that a student will be able to demonstrate upon successful completion of a course. Both instructor and student are obligated to follow the content of the course outline. It is your responsibility to meet these outcomes as assigned.

Note: You should maintain a copy of this course outline for your records. You may require this course outline if you seek transfer credits or further studies at other institutions.

Cambrian Email Addresses

All email correspondence with currently registered students must be via the students' College-issued email, as per the College's IT Acceptable Use Policy. Students must familiarize themselves with the IT Acceptable Use Policy, as it outlines the acceptable use of College information systems and technology, and mitigates risks to the College's IT infrastructure.

Bring Your Own Device (BYOD) and Apps Anywhere

Cambrian College is a BYOD institution, which means that students bring the device of their choice that meets program-specific minimum technology requirements. Program-specific minimum technology requirements can be viewed on program pages on the Cambrian College website. AppsAnywhere is an easy-to-use app store-like platform providing students with a way to access their College apps and software on demand, anywhere, anytime both on and off campus. These both enrich the student learning experience in and out of the classroom, while providing maximum flexibility.

Policies

It is the student's responsibility to be aware of the College's policies. Policies, procedures and forms can be found on the College website.

Academic and Student Services

Cambrian has a variety of student and academic services to support students during their academic journey at the College.

- • Academic Integrity Office
- Academic Success Centre
- Bookstore and Campus Store
- International Student Support Services
- KPMG Pride Centre
- Career Centre
- Registrar's Office (Enrolment Centre)
- First Step Centre
- Accessibility Services
- Library
- Pathways
- Available Scholarships and Bursaries
- Cambrian Student Council (CSC)
- Cambrian Indigenous Student Circle (CISC)
- Cambrian Athletic Association (CAA)

- Student Life Centre
- Test Centre
- The Learning Centre [Tutoring Services]
- Wabnode Centre for Indigenous Services
- Women's Resource Centre

Copyright

Copyright is the exclusive legal right given to a creator to reproduce, publish, sell, or distribute his/her work. All members of the Cambrian community are required to comply with Canadian copyright law, which governs the reproduction, use and distribution of copyrighted materials. This means that the copying, use and distribution of copyright-protected materials, regardless of format, are subject to certain limits and restrictions. For example, activities such as photocopying or scanning an entire textbook or uploading class materials to a course sharing site are prohibited.

See the Cambrian Library website for additional information regarding copyright and for details on allowable limits.

Audio/Visual Capture

Sounds and images from this class, and contributions made by a participant, virtually or in-person, are recorded under the authority of the *Ontario Colleges of Applied Arts and Technology Act, 2002*. The main purpose of these recordings is to allow students enrolled in the course to review content and engage in activities, whether they attend any given class in person, virtually, or at all. Class recordings are for personal use only and shall not be shared or transferred. Faculty may also review these recordings to prepare for future classes, evaluate students, collaborate in program reviews, or provide feedback to faculty and/or students. Any questions about the use of multimedia recordings may be addressed to your respective Dean.

Equity, Diversity, and Inclusivity

Cambrian is committed to building and preserving an equitable, diverse, and inclusive learning community where students, faculty, and staff may achieve their full potential in an environment characterized by equality of respect and opportunity. All students and employees have the right to live and work in an environment that is free from discrimination and harassment. Therefore, Cambrian College will not tolerate any form of discrimination or harassment in its employment, education, accommodation, or business dealings. For more information, please visit: Equity, Human Rights, and Accessibility.

Prior Learning Assessment and Recognition (PLAR)

Students wishing to have work or life experience that meets course learning outcomes considered for credit through Prior Learning Assessment and Recognition should email the Enrolment Centre at records@cambriancollege.ca.

Transfer Credit

Students wishing to have courses from other programs or institutions assessed for equivalency and/or transfer credit should visit the Transfer Credits page on the Cambrian website. The student should maintain a copy of this course outline for their records. Students may require this course outline if seeking transfer credits or further studies at other institutions.

Test Proctoring at Cambrian

Many courses include major tests and/or final exams. The practice at Cambrian requires that these types of test situations involve proctoring to ensure academic integrity. Online tests/exams may employ a proctoring services to enable you to take your exam from a location of your choosing within a period specified by your instructor. When you are taking an online test/exam, the proctoring service may capture your video, screen, audio, and web surfing data to protect academic integrity. Cambrian College collects, uses, discloses, and retains personal information in compliance with the

Freedom of Information and Protection of Privacy Act (FIPPA). Your personal information is being collected under the authority of the *Ontario Colleges of Applied Arts and Technology Act S.O. 2002, c.8, Sched. F*. This information will be used for the purpose of administering a test/exam through an online proctoring service acting as an authorized agent of the College. Please refer to Cambrian's Official Student Records Policy for more details. If you have any questions regarding the collection of your personal information, please contact Vice President Academic, Cambrian College, 1400 Barry Downe Rd., Sudbury ON P3A 3V8, 1-705-566-8101 ext. 6245.

Schools of Skilled Training, Engineering Technology & Environmental Studies Regulations

Lab Attendance
This course includes a mandatory lab component. The grading in this course will include the evaluation of lab reports and performance during labs.

Cambrian College

Schools of Skilled Training, Engineering Technology & Environmental Studies
Course Outline

We acknowledge and respect that we are gathered on the traditional lands of the Anishnaabe People of Turtle Island and proudly recognize our local host Atikameksheng Anishnawbek. We also recognize the contributions of Wahnapitae First Nation and the Metis Nation of Ontario.

Course Title	Wheel Assemblies and Brakes				
Course Code:	HDA1186	Credit Value:	2	Credit Hours:	28
Programs:	HEDC Commercial Vehcile & Heavy Equipment - Dual Credit HTAP Heavy Equipment Techniques				
Equivalencies		Prerequisites		Corequisites	GOM1142

This course may be delivered in a variety of different formats: 100% in-class, 100% online (or a blend of both), videoconferencing, distributed learning or off-campus. Please confirm with your faculty member which format will be used for your section of this course.

General Education Course:	☐	Eligible for PLAR:	☑
Degree Breadth Course:	☐	Experiential Learning:	☐
Research Intensive Course Designation:	☐		

COURSE DESCRIPTION

In this course, students will be able to perform adjustments and repairs to wheel end assemblies following manufacturers' recommendations. They will also be able to recommend repairs to hydraulic brake systems and perform repairs to air brake systems following manufacturers' recommendations and statutory criteria.

Date: June 11, 2026

Approved by:

ANGELA GILMORE
Chair, Schools Of Skilled Training, Engineering Technology & Environmental Studies

Effective: Fall 2026, Winter 2027, Spring 2027

RELATIONSHIP TO PROGRAM VOCATIONAL LEARNING OUTCOMES

PROGRAM LEVEL	
This course contributes to your program by allowing you to demonstrate the following vocational learning outcomes:	
Program(s)	**Vocational Learning Outcomes**
Commercial Vehcile & Heavy Equipment - Dual Credit	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Identify, inspect, test and maintain basic suspension, steering, and brake components and systems in compliance with manufacturers' recommendations. 3. Disassemble and assemble heavy duty equipment components to required specifications. 4. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 5. Prepare logs, records, and documentation to appropriate standards. 6. Apply communication skills to improve customer service. 7. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.
Heavy Equipment Techniques - Apprenticeship	**Apprenticeship Standards** 1. Identify basic heavy duty equipment system problems using critical thinking skills and strategies and by applying fundamental knowledge of heavy duty equipment operation, components and their interrelationships. 2. Identify, inspect, test and maintain basic suspension, steering, and brake components and systems in compliance with manufacturers' recommendations. 3. Disassemble and assemble heavy duty equipment components to required specifications. 4. Use information technology and computer skills to access data concerning repair procedures and manufacturers' updates. 5. Prepare logs, records, and documentation to appropriate standards. 6. Apply communication skills to improve customer service. 7. Complete all assigned work in compliance with occupational, health, safety, and environmental law; established policies and procedures; codes and regulations; and in accordance with ethical principles.

COURSE CURRICULUM

Topics/Concepts Covered in This Course

- S1247.1 Wheel End Assemblies
- S1247.2 Hydraulic Brake Systems
- S1247.3 Air Brake Systems

COURSE LEVEL: Learning Outcomes and Objectives		
To earn credit for this course, you must reliably demonstrate your ability to:		
Learning Outcome	**Objectives**	**Competency Profile**
1. Perform adjustments and repairs to wheel end assemblies following manufacturers' recommendations.	1.1 Explain the fundamentals of wheel end assemblies. - sliding and rolling friction - load carrying bearing - lubrication - tire and rim safety - safe wheel removal and installation procedures - hub-piloted - stud-piloted - cast spoke - multi piece 1.2 Identify the construction, composition, types, styles and application of wheel end assemblies. - bearing and retaining locks - tapered roller - cups - cones - ball bearing - race - cage assembly - preset hubs - tire and rim safety - safe wheel removal and installation procedures - hub-piloted - stud-piloted - cast spoke - multi piece rims	S1247.1

Learning Outcome	Objectives	Competency Profile
	1.3 Describe the principle(s) of operation of wheel end assemblies. - lubrication - oil - grease - synthetic - API specifications - reduced maintenance - endplay - preload - preset hubs 1.4 Perform inspection and installation procedures of wheel end assemblies. - visual inspection - bearing match - bearing endplay - bearing fit - hub condition - spindle condition 1.5 Recommend reconditioning or repairs following manufacturers' procedures on wheel end assemblies. - remove and Install a wheel end assembly following recommended procedures using the following: - Technical and Maintenance Council (TMC) procedure - Original Equipment Manufacturers (OEM) procedure - inspect and service seals as required following manufactures recommended service procedures - bearing cleaning precautions - preset hubs	

Learning Outcome	Objectives	Competency Profile
2. Recommend repairs to hydraulic brake systems following manufacturers' recommendations.	2.1 Explain the purpose and fundamentals of braking system assemblies. - Pascal's law - laws of levers, mechanical advantages - friction - co-efficient of friction - brake fluids - servo-action - self-energizing - velocity and acceleration - torque multiplication - displacement - identify appropriate legislation governing brake systems (e.g. CMVSS-105) 2.2 Identify the construction features, composition, types, and styles of brake system components. - brake lines and hoses - master cylinders - wheel cylinders - calipers - brake shoes and disc pads - drums and rotors - control and metering devices - self-adjusting devices - hand and parking brake cables - brake fluids 2.3 Describe the principles of operation of brake system components. - master cylinders - wheel cylinders - calipers - shoes and pads - control and metering devices - self-adjusters - drums and rotors - hand and parking brake cables	S1247.2

Learning Outcome	Objectives	Competency Profile
	2.4 Perform reconditioning or repairs following manufacturers' procedures for hydraulic system components. - fabricate brake lines - bend - flare - double and bubble - service - master and wheel cylinder and bleeding of air from the system - calipers, mounting hardware, boots, and piston seals - shoes and pads, mounting hardware, and backing plates - adjusting devices - hand and parking brake assembly	
3. Perform repairs to air brake systems following manufacturers' recommendations and statutory criteria.	3.1 Explain the purpose and fundamentals of basic air brake systems. - laws of levers - mechanical advantages - co-efficient of friction - pressure volume relationship - spring brake chamber calculations - potential energy - linear force - leverage - brake torque - brake friction factors - effects of vehicle load and speed - Canadian Motor Vehicle Safety Standards (CMVSS) 121 - Commercial Vehicle Safety Alliance (Out-of-service OOS citations)	S1247.3

Learning Outcome	Objectives	Competency Profile
	3.2 Identify the functions, construction features, composition, types, and application of basic air brake systems. - air supply system - primary service circuit - secondary service circuit - park/emergency circuit - foundation assemblies - S-cam - wedge - disc - slack adjusters - actuator chambers 3.3 Describe the principle(s) of operation of wheel end assemblies. - air supply system - primary service circuit - secondary service circuit - park/emergency circuit - foundation assemblies - S-cam - wedge - disc - slack adjusters - actuator chambers - hoses, lines, and fittings 3.4 Perform inspection and testing procedures following manufacturers' recommendations on air brake systems. - foundation brake checks for: - stroke length - automatic slack adjusters - outline procedure for air compressor, air dryer, air receiver and testing - check governor operation - interpret pneumatic schematics - interpret statutory inspection safety criteria	

Learning Outcome	Objectives	Competency Profile
	3.5 Recommend reconditioning or repair following manufacturers' recommendations to air brake systems. - demonstrate how to disarm spring brake chambers following recommended safe practices - service foundation components: - relining - machining practices - performing complete wheel-end service - disc brake components - servicing pneumatic circuit components - performing air brake adjustment according to recommended procedures - interpretation of statutory specifications	

Essential Employability Skills

Communication
- communicate clearly in written, spoken, and visual form that fulfills purpose/ needs of audience.
- respond to written, spoken, or visual messages in a manner that ensures effective communication.

Numeracy
- execute mathematical operations accurately.

Critical Thinking and Problem Solving
- apply a systematic approach to solve problems.
- use a variety of thinking skills to anticipate and solve problems.

Information Management
- locate, select, organize, and document information using appropriate technology and info systems.
- analyze, evaluate, and apply relevant information from a variety of sources.

Interpersonal
- show respect for the diverse opinions, values, belief systems, and contributions of others.
- interact with others in groups in ways that contribute to effective working relationships.

Personal
- manage the use of time and other resources to complete projects.
- take responsibility for one's own actions, decisions, and consequences.

Delivery Method
- Classroom: Course is delivered through scheduled synchronous teaching that may be face-to-face and/or virtual.

Learning Activities

- Lectures
- Class Discussions
- Labs
- Group Work
- Research
- Self-Directed Learning
- Scenario Testing
- Physical Activity
- In-Class Exercises
- Small Group Instruction
- One-to-One Instruction
- eLearning Components

Resources Required

Additional Supplies

Coveralls
Fire Resistant one piece coveralls
Estimated Cost: 150

Laptop
Capable of running excel, word, paint and internet
Estimated Cost: 1500

Safety Glasses
CSA approved with clear lenses
Estimated Cost: 50

CDX Fundamentals of Mobile Heavy Equipment
Estimated Cost: 200

Safety Boots
CSA approves, 8" high, steel toe
Estimated Cost: 200

Fundamentals of Mobile Heavy Equipment
Estimated Cost: 200

Evaluation Plan

Grading Scheme

A	80%	-	100%
B	70%	-	79%
F	0%	-	69%

Evaluation Method	Value (%)
Test/Exam	**30%**
2 Test/Exams of equal value	

Evaluation Method	Value (%)
Quizzes	**20%**
2 Scheduled Moodle Activities, consisting of Quizzes, and Theory Assignments of equal value.	
Applied Activities (G)	**50%**
5 Scheduled Lab Evaluations of equal value	

ADDITIONAL INFORMATION

A course outline is the College's commitment to the students. It supports educators, students, employers, and external partners in determining the depth of knowledge and level of performance that a student will be able to demonstrate upon successful completion of a course. Both instructor and student are obligated to follow the content of the course outline. It is your responsibility to meet these outcomes as assigned.

Note: You should maintain a copy of this course outline for your records. You may require this course outline if you seek transfer credits or further studies at other institutions.

Cambrian Email Addresses

All email correspondence with currently registered students must be via the students' College-issued email, as per the College's IT Acceptable Use Policy. Students must familiarize themselves with the IT Acceptable Use Policy, as it outlines the acceptable use of College information systems and technology, and mitigates risks to the College's IT infrastructure.

Bring Your Own Device (BYOD) and Apps Anywhere

Cambrian College is a BYOD institution, which means that students bring the device of their choice that meets program-specific minimum technology requirements. Program-specific minimum technology requirements can be viewed on program pages on the Cambrian College website. AppsAnywhere is an easy-to-use app store-like platform providing students with a way to access their College apps and software on demand, anywhere, anytime both on and off campus. These both enrich the student learning experience in and out of the classroom, while providing maximum flexibility.

Policies

It is the student's responsibility to be aware of the College's policies. Policies, procedures and forms can be found on the College website.

Academic and Student Services

Cambrian has a variety of student and academic services to support students during their academic journey at the College.

- • Academic Integrity Office
- Academic Success Centre
- Bookstore and Campus Store
- International Student Support Services
- KPMG Pride Centre
- Career Centre
- Registrar's Office (Enrolment Centre)
- First Step Centre
- Accessibility Services
- Library
- Pathways
- Available Scholarships and Bursaries

- Cambrian Student Council (CSC)
- Cambrian Indigenous Student Circle (CISC)
- Cambrian Athletic Association (CAA)
- Student Life Centre
- Test Centre
- The Learning Centre [Tutoring Services]
- Wabnode Centre for Indigenous Services
- Women's Resource Centre

Copyright

Copyright is the exclusive legal right given to a creator to reproduce, publish, sell, or distribute his/her work. All members of the Cambrian community are required to comply with Canadian copyright law, which governs the reproduction, use and distribution of copyrighted materials. This means that the copying, use and distribution of copyright-protected materials, regardless of format, are subject to certain limits and restrictions. For example, activities such as photocopying or scanning an entire textbook or uploading class materials to a course sharing site are prohibited.

See the Cambrian Library website for additional information regarding copyright and for details on allowable limits.

Audio/Visual Capture

Sounds and images from this class, and contributions made by a participant, virtually or in-person, are recorded under the authority of the *Ontario Colleges of Applied Arts and Technology Act, 2002*. The main purpose of these recordings is to allow students enrolled in the course to review content and engage in activities, whether they attend any given class in person, virtually, or at all. Class recordings are for personal use only and shall not be shared or transferred. Faculty may also review these recordings to prepare for future classes, evaluate students, collaborate in program reviews, or provide feedback to faculty and/or students. Any questions about the use of multimedia recordings may be addressed to your respective Dean.

Equity, Diversity, and Inclusivity

Cambrian is committed to building and preserving an equitable, diverse, and inclusive learning community where students, faculty, and staff may achieve their full potential in an environment characterized by equality of respect and opportunity. All students and employees have the right to live and work in an environment that is free from discrimination and harassment. Therefore, Cambrian College will not tolerate any form of discrimination or harassment in its employment, education, accommodation, or business dealings. For more information, please visit: Equity, Human Rights, and Accessibility.

Prior Learning Assessment and Recognition (PLAR)

Students wishing to have work or life experience that meets course learning outcomes considered for credit through Prior Learning Assessment and Recognition should email the Enrolment Centre at records@cambriancollege.ca.

Transfer Credit

Students wishing to have courses from other programs or institutions assessed for equivalency and/or transfer credit should visit the Transfer Credits page on the Cambrian website. The student should maintain a copy of this course outline for their records. Students may require this course outline if seeking transfer credits or further studies at other institutions.

Test Proctoring at Cambrian

Many courses include major tests and/or final exams. The practice at Cambrian requires that these types of test situations involve proctoring to ensure academic integrity. Online tests/exams may employ a proctoring services to enable you to take your exam from a location of your choosing

within a period specified by your instructor. When you are taking an online test/exam, the proctoring service may capture your video, screen, audio, and web surfing data to protect academic integrity. Cambrian College collects, uses, discloses, and retains personal information in compliance with the *Freedom of Information and Protection of Privacy Act (FIPPA)*. Your personal information is being collected under the authority of the *Ontario Colleges of Applied Arts and Technology Act S.O. 2002, c.8, Sched. F*. This information will be used for the purpose of administering a test/exam through an online proctoring service acting as an authorized agent of the College. Please refer to Cambrian's Official Student Records Policy for more details. If you have any questions regarding the collection of your personal information, please contact Vice President Academic, Cambrian College, 1400 Barry Downe Rd., Sudbury ON P3A 3V8, 1-705-566-8101 ext. 6245.