COURSE MEC1010: MODES & MECHANISMS

Level: Introductory

Prerequisite: None

Description: Students research, design, build and test a model of a transportation vehicle, using a simple power source, common materials and tools.

Parameters: Access to tools and fasteners commonly used in the trade.

Outcomes: The student will:

1. **demonstrate the safe use of tools and follow established laboratory procedures**
   - 1.1 demonstrate knowledge of and follow safety rules and guidelines related to the use of basic hand and power tools
   - 1.2 identify the hazards associated with the use of:
     - 1.2.1 compressed gases
     - 1.2.2 liquids under pressure
     - 1.2.3 flammable materials
     - 1.2.4 components under tension
2. **list and describe operating systems and structures common to all modes of transportation**
   - 2.1 identify a transportation mode that can be used to move passengers or goods in the following environments:
     - 2.1.1 terrestrial
     - 2.1.2 marine
     - 2.1.3 atmospheric
     - 2.1.4 space
   - 2.2 describe, in a given environment, what forces must be overcome to start and keep a vehicle/craft in motion
   - 2.3 list and describe the function of the following systems:
     - 2.3.1 propulsion
     - 2.3.2 guidance
     - 2.3.3 control
     - 2.3.4 suspension
     - 2.3.5 structural
     - 2.3.6 solar and wind
   - 2.4 describe and demonstrate how energy produces motion using:
     - 2.4.1 gravity
     - 2.4.2 elastic or spring materials under tension
     - 2.4.3 compressed gases
     - 2.4.4 liquids under pressure
     - 2.4.5 electromagnetic combustion
   - 2.5 identify and compare the guidance and control mechanisms that are used in connection with a:
     - 2.5.1 land vehicle
     - 2.5.2 marine craft
     - 2.5.3 aircraft
     - 2.5.4 spacecraft

2.6 identify and compare the means by which a vehicle or craft is supported:
    2.6.1 on land
    2.6.2 in air
    2.6.3 in water or space
2.7 identify the types of structures and materials that are used to support vehicular systems to provide maximum safety and performance

3. research, design, build and test a concept vehicle

3.1 research, design and construct a vehicle or craft for a predetermined use
3.2 identify an appropriate measurement technique used to assess factors including:
    3.2.1 speed
    3.2.2 pulling power
    3.2.3 payload
    3.2.4 efficiency
3.3 describe operation and construction of the transportation vehicle

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
5.2 create a connection between a personal inventory and occupational choices

COURSE MEC1015: MECHANICS TOOLS & MATERIALS

Level: Introductory

Prerequisite: None

Description: Students develop knowledge, skills and attitudes in the safe use of specialty hand tools, measuring tools and fasteners.

Parameters: Access to tools and fasteners commonly used in the trade.

Outcomes: The student will:

1. **create a health and safety plan with special emphasis on conditions and factors related to the specific pathway or series of courses**
   - 1.1 research and identify the following eight common elements of a health and safety management system:
     - 1.1.1 management, leadership and organizational commitment including policies, guidelines and responsibilities
     - 1.1.2 hazard identification and assessment
     - 1.1.3 hazard control
     - 1.1.4 worker competency and training including: technical competence, safe work practices and procedures, personal protective equipment
     - 1.1.5 work site inspection
     - 1.1.6 incident investigation
     - 1.1.7 emergency response
     - 1.1.8 management system administration including: evaluation, records and statistics, maintenance of system
   - 1.2 explain each of the elements reflecting on occupational health and safety implications
   - 1.3 define health and safety elements relevant to the world-of-work
   - 1.4 present a health and safety plan clarifying its relevance to the work world and society in general
2. **research common processes and methods of hazard identification, assessment and control specific to the pathway or series of courses**
   - 2.1 research and identify common job site hazard identification processes
   - 2.2 research and identify common methods for assessment and control of hazards
   - 2.3 explain and demonstrate appropriate health and safety effective practices
   - 2.4 demonstrate a proactive personal commitment toward improvement of workplace health and safety including concern for others and following instructions, rules and guidelines
3. **identify, describe and demonstrate the safe and correct use of shop procedures and equipment**
   - 3.1 demonstrate knowledge of and follow safety rules and guidelines related to the use of specialty hand and measuring tools, as well as shop/laboratory routines
   - 3.2 identify the hazards with the use of:
     - 3.2.1 adhesives
     - 3.2.2 sealers
4. **identify, describe and demonstrate the safe and correct use of power and specialty hand tools used in the trade**
   - 4.1 identify and describe the following common specialty tools:
     - 4.1.1 tube flare kit
     - 4.1.2 tubing cutter
     - 4.1.3 tubing bender
     - 4.1.4 twist drills

4.1.5 reamers
4.1.6 taps and tap handles
4.1.7 dies and diestock
4.1.8 stud extractors
4.1.9 pneumatic tools
4.1.10 drill press
4.1.11 pedestal grinder
4.1.12 vises
4.1.13 hack saws

5. identify, describe and demonstrate the safe and correct use of measuring tools used in the trade

5.1 describe and use the following common measuring tools:
5.1.1 steel rule
5.1.2 feeler blades
5.1.3 vernier, dial and digital slide calipers
5.1.4 micrometer
5.1.5 dial indicator
5.1.6 transfer gauges
5.1.7 Plastigauge™
5.1.8 torque wrench
5.1.9 pull scale

6. list and describe fastening devices used in the trade

6.1 identify and describe the following:
6.1.1 threaded fasteners
6.1.2 bolt grades
6.1.3 bolt identification
6.1.4 nuts
6.1.5 washers
6.1.6 torquing techniques
6.1.7 snap rings and clips
6.1.8 set screws
6.1.9 keys
6.1.10 splines
6.1.11 pins
6.1.12 plastic trim fasteners
6.2 describe the use of:
6.2.1 adhesives
6.2.2 sealers

7. demonstrate proper techniques when using fastening devices

7.1 select or modify a plan for a simple product that will meet a defined need
7.2 identify and select the appropriate tools, materials and processes required to make the product
7.3 list the steps that are required to make a product in a safe and logical order
7.4 demonstrate the following tasks:
7.4.1 tap a blind hole
7.4.2 cut threads with a die and diestock
7.4.3 repair threads using thread-restoring inserts
7.4.4 broken fastener removal
7.4.5 convert numbers between decimals and fractions
7.4.6 identify linear measurements in imperial and SI units
7.4.7 identify torque measurements in imperial and SI units

8. demonstrate basic competencies

8.1 demonstrate fundamental skills to:
- 8.1.1 communicate
- 8.1.2 manage information
- 8.1.3 use numbers
- 8.1.4 think and solve problems

8.2 demonstrate personal management skills to:
- 8.2.1 demonstrate positive attitudes and behaviours
- 8.2.2 be responsible
- 8.2.3 be adaptable
- 8.2.4 learn continuously
- 8.2.5 work safely

8.3 demonstrate teamwork skills to:
- 8.3.1 work with others
- 8.3.2 participate in projects and tasks

9. make personal connections to the cluster content and processes to inform possible pathway choices

9.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences

9.2 create a connection between a personal inventory and occupational choices

COURSE MEC1020: VEHICLE SERVICE & CARE

Level: Introductory

Prerequisite: None

Description: Students develop the knowledge, skills and attitudes to care for and service a motor vehicle.

Parameters: Access to commercially available products and related resources.

Note: Customer work must be checked by a qualified technician.

Outcomes: The student will:

1. **demonstrate the safe use of tools and follow established laboratory procedures**
   - 1.1 demonstrate knowledge of and follow practices that promote safety and protect the environment
2. **develop a preventive maintenance service schedule for a vehicle**
   - 2.1 explain why preventive maintenance can:
     - 2.1.1 avoid expensive repairs
     - 2.1.2 improve reliability and safety
     - 2.1.3 improve efficiency
     - 2.1.4 extend the life of the vehicle
   - 2.2 identify and locate a vehicle's major mechanical and structural components that need regular service and care
   - 2.3 identify and safely use common hand tools and equipment
   - 2.4 identify from the owner's manual the recommended:
     - 2.4.1 type and grade of motor oil
     - 2.4.2 type of engine coolant
     - 2.4.3 brake fluid
     - 2.4.4 power steering fluid
     - 2.4.5 transmission fluid
     - 2.4.6 type of filters
   - 2.5 identify potential trouble signs including:
     - 2.5.1 warning lights or gauges
     - 2.5.2 unusual odours or noises
     - 2.5.3 burning oil
     - 2.5.4 leaks
     - 2.5.5 other
3. **inspect and service a vehicle according to the vehicle service schedule**
   - 3.1 identify the components of a work order
   - 3.2 prepare a repair order
   - 3.3 prepare a service schedule using the owner's manual or a shop manual to determine when to:
     - 3.3.1 change lubrication fluids
     - 3.3.2 replace filters
     - 3.3.3 drain and replace coolants
     - 3.3.4 lubricate body components
     - 3.3.5 inspect and lubricate suspension and steering joints
     - 3.3.6 inspect brake linings

3.3.7 repack wheel bearings
3.3.8 rotate tires
3.3.9 other

3.4 demonstrate a visual inspection of:
3.4.1 fluid levels
3.4.2 hose and belt condition
3.4.3 tire pressure and condition
3.4.4 lights and accessories
3.4.5 battery condition

3.5 demonstrate the procedure used to:
3.5.1 replace engine motor oil, coolant and filters
3.5.2 lubricate chassis and body parts
3.5.3 clean and check the battery condition
3.5.4 rotate tires
3.5.5 check tire pressure
3.5.6 dispose of used fluids and parts
3.5.7 remove and replace a tire and rim from a vehicle
3.5.8 boost (jump-start) a vehicle
3.5.9 demonstrate basic troubleshooting on a stalled vehicle

4. clean and apply a protective coating to the exterior and interior surfaces of a vehicle for use or storage

4.1 describe what steps should be taken when a vehicle is stored for a period of time

4.2 explain why it is necessary to shelter or protect a vehicle from:
4.2.1 the sun's radiation
4.2.2 salt
4.2.3 heat and cold
4.2.4 other

4.3 identify and demonstrate the use of products that can be safely used to:
4.3.1 clean a painted surface
4.3.2 degrease components
4.3.3 wax and polish a surface
4.3.4 other; e.g., chip protection

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:
5.1.1 communicate
5.1.2 manage information
5.1.3 use numbers
5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
5.2.1 demonstrate positive attitudes and behaviours
5.2.2 be responsible
5.2.3 be adaptable
5.2.4 learn continuously
5.2.5 work safely

5.3 demonstrate teamwork skills to:
5.3.1 work with others
5.3.2 participate in projects and tasks

6. make personal connections to the cluster content and processes to inform possible pathway choices

6.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences

6.2 create a connection between a personal inventory and occupational choices

COURSE MEC1040: ENGINE FUNDAMENTALS

Level: Introductory

Prerequisite: None

Description: Students investigate and describe operating principles, construction and applications of engines.

Parameters: Access to engine measuring tools, related resources and engine units.

Outcomes: The student will:

1. **demonstrate the safe use of tools and follow established laboratory procedures**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 describe the hazards associated with:
     - 1.2.1 gasoline and other flammable liquids
     - 1.2.2 exhaust gases
     - 1.2.3 hot coolants and liquids
2. **compare operating principles of two- and four-cycle piston engines**
   - 2.1 identify and use measuring tools in both imperial and metric systems of measurement including:
     - 2.1.1 steel rule
     - 2.1.2 callipers and dividers
     - 2.1.3 micrometer
     - 2.1.4 dial indicator
     - 2.1.5 torque wrench
     - 2.1.6 pressure gauges
     - 2.1.7 other
   - 2.2 identify and use fasteners associated with engines (measurements in both imperial and metric) including:
     - 2.2.1 bolts, studs and nuts
     - 2.2.2 washers
     - 2.2.3 pins
     - 2.2.4 keys
     - 2.2.5 snap rings
     - 2.2.6 machine screws
     - 2.2.7 other
   - 2.3 describe the effects of heating a gas in an enclosed space
   - 2.4 identify the types of fuels commonly used in combustion engines
   - 2.5 describe the difference between an internal and external combustion engine
   - 2.6 identify the type of engines and fuels that are used for air, land, sea and space applications
3. **determine the condition of an internal combustion engine**
   - 3.1 locate and use resources related to:
     - 3.1.1 service bulletins and repair manuals
     - 3.1.2 engine specifications documentation
     - 3.1.3 parts numbers and assembly procedures
   - 3.2 identify and label the major parts of a reciprocating engine
   - 3.3 demonstrate how reciprocating motion is converted to rotary motion
   - 3.4 explain the difference between a two- and a four-stroke cycle engine

3.5 explain the purpose of the following support systems:
    3.5.1 cooling
    3.5.2 lubrication
    3.5.3 ignition
    3.5.4 fuel
    3.5.5 exhaust
3.6 demonstrate how engines differ according to their:
    3.6.1 number of cylinders
    3.6.2 design
    3.6.3 size
    3.6.4 make and model
    3.6.5 other
3.7 appraise the condition of an engine

4. describe the by-products of combustion and their impact on the environment

4.1 describe the by-products of combustion and their effects on personal health and the environment

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:
    5.1.1 communicate
    5.1.2 manage information
    5.1.3 use numbers
    5.1.4 think and solve problems
5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. make personal connections to the cluster content and processes to inform possible pathway choices

6.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
6.2 create a connection between a personal inventory and occupational choices

COURSE MEC1090: ELECTRICAL FUNDAMENTALS

Level: Introductory

Prerequisite: None

Description: Students identify and describe the operating principles and applications of electricity.

Parameters: Access to a multimeter, a battery hydrometer, a battery charger, related battery tools and electrical supplies.

Outcomes: The student will:

1. **demonstrate the safe use of electrical tools and equipment and follow established laboratory procedures**
   - 1.1 safely use tools/equipment and follow established laboratory procedures
   - 1.2 identify causes of battery explosion/acid burns
   - 1.3 describe electrical shock/burns/fires
   - 1.4 outline a plan of action when an accident occurs
2. **apply electrical principles and concepts to test electrical circuits and components**
   - 2.1 describe magnetic attraction and repulsion
   - 2.2 produce a temporary and permanent magnet
   - 2.3 find the polarity of an electromagnet
   - 2.4 describe the electron theory in relation to the parts of an atom
   - 2.5 describe production of electricity in the following ways:
     - 2.5.1 chemically
     - 2.5.2 thermally
     - 2.5.3 photoelectrically
     - 2.5.4 piezoelectrically
     - 2.5.5 electromagnetically
   - 2.6 explain the difference between AC and DC current
   - 2.7 identify and label the parts of a simple circuit
   - 2.8 identify the physical form and circuit symbol of a:
     - 2.8.1 light
     - 2.8.2 motor
     - 2.8.3 heating element
     - 2.8.4 solenoid
     - 2.8.5 fuse
     - 2.8.6 other
   - 2.9 describe what conditions create:
     - 2.9.1 an open circuit
     - 2.9.2 a closed circuit
     - 2.9.3 a short circuit
     - 2.9.4 a grounded circuit
   - 2.10 describe how a frame ground circuit operates on a motor vehicle

2.11 define what is meant by:
- 2.11.1 amperage
- 2.11.2 voltage
- 2.11.3 resistance

2.12 compare the similarity between electrical and fluid energy
2.13 construct and compare a series and a parallel circuit
2.14 measure, with appropriate meters, the resistance, voltage and amperage in a given circuit
2.15 describe the relationship that exists among the amperage, voltage and resistance within a circuit
2.16 describe the condition of a battery and service

3. demonstrate basic competencies

3.1 demonstrate fundamental skills to:
- 3.1.1 communicate
- 3.1.2 manage information
- 3.1.3 use numbers
- 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:
- 3.2.1 demonstrate positive attitudes and behaviours
- 3.2.2 be responsible
- 3.2.3 be adaptable
- 3.2.4 learn continuously
- 3.2.5 work safely

3.3 demonstrate teamwork skills to:
- 3.3.1 work with others
- 3.3.2 participate in projects and tasks

4. make personal connections to the cluster content and processes to inform possible pathway choices

4.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
4.2 create a connection between a personal inventory and occupational choices

COURSE MEC1110: PNEUMATICS & HYDRAULICS

Level: Introductory

Prerequisite: None

Description: Students identify and describe the operating principles and applications of pneumatic and hydraulic systems.

Parameters: Access to related pneumatic and hydraulic units and resources.

Outcomes: The student will:

1. **demonstrate the safe use of pneumatic and hydraulic tools and equipment and follow established laboratory procedures**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 list hazards related to working with fluids and gases under pressure and related equipment
2. **compare operating principles of pneumatic and hydraulic systems**
   - 2.1 state why fluid systems are widely used in transportation and power applications
   - 2.2 contrast hydraulic and pneumatic systems
   - 2.3 demonstrate how pressure affects a liquid and a gas in an enclosed space
   - 2.4 describe what units are used to measure pressure in a fluid
   - 2.5 describe what units are used to calculate the flow of fluid past a point
   - 2.6 demonstrate the relationship between flow rate and pressure in a fluid system
   - 2.7 describe how a small force can be multiplied in a fluid system
   - 2.8 contrast the action of common pumps and compressors including:
     - 2.8.1 impeller
     - 2.8.2 gear
     - 2.8.3 piston
     - 2.8.4 diaphragm
     - 2.8.5 vane type
   - 2.9 locate examples of these pumps and compressors in a motor vehicle or some other power system
3. **apply principles and concepts of pneumatics and hydraulics to test and operate a pneumatic and/or hydraulic system**
   - 3.1 observe and demonstrate the use of valves to control:
     - 3.1.1 direction of flow
     - 3.1.2 pressure of fluids
     - 3.1.3 flow rate of fluids
   - 3.2 locate valves on a given vehicle
   - 3.3 demonstrate how fluids under pressure can be used to move a:
     - 3.3.1 motor
     - 3.3.2 cylinder
     - 3.3.3 diaphragm
   - 3.4 identify and operate pneumatic and hydraulic units on a given vehicle
   - 3.5 describe the principles in a fluid system such as:
     - 3.5.1 hydraulic hoist
     - 3.5.2 hydraulic brakes

3.6 demonstrate how to check and adjust fluid levels
3.7 demonstrate how to double and single flare a steel line and indicate when each flare type should be used

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences

5.2 create a connection between a personal inventory and occupational choices

COURSE MEC1130: MECHANICAL SYSTEMS

Level: Introductory

Prerequisite: None

Description: Students identify and describe the operating principles and applications of mechanisms used to transmit and control mechanical energy.

Parameters: Access to examples of mechanical units and related resources.

Outcomes: The student will:

1. **demonstrate the safe use of tools and follow established laboratory procedures**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 explain dangers associated with rotating/moving components
2. **describe principles and concepts related to the use of mechanisms to control and transmit force and motion in a mechanical system**
   - 2.1 describe the application of mechanical systems that are found in all aspects of human endeavour
   - 2.2 demonstrate the use of simple machines to change the:
     - 2.2.1 direction in which a force acts
     - 2.2.2 size of the force
     - 2.2.3 place where the force acts
   - 2.3 identify and describe a mechanism that produces:
     - 2.3.1 linear motion
     - 2.3.2 reciprocating motion
     - 2.3.3 oscillating motion
     - 2.3.4 rotary motion
     - 2.3.5 other
   - 2.4 use a graph to describe the action of a cam as it changes rotary motion to linear motion
   - 2.5 explain the difference between direct and indirect transmission of power
   - 2.6 describe the purpose and types of:
     - 2.6.1 shafts
     - 2.6.2 couplers
     - 2.6.3 universal joints
     - 2.6.4 pins
     - 2.6.5 others
3. **apply basic principles and concepts of mechanical systems**
   - 3.1 demonstrate the use of simple machines to:
     - 3.1.1 start and stop motion
     - 3.1.2 change directions
     - 3.1.3 increase or decrease speed
     - 3.1.4 increase or decrease torque
   - 3.2 describe the relationship between torque, velocity and gear ratios
   - 3.3 explain why friction has both positive and negative attributes
   - 3.4 compare the coefficient of friction between two different materials
   - 3.5 describe how friction can be increased or decreased in a mechanical system
   - 3.6 calculate the mechanical advantage of one or more mechanisms to determine the efficiency of the system

3.7 explain how mechanical energy can be changed to:
    3.7.1 heat energy
    3.7.2 electrical energy
    3.7.3 fluid energy
    3.7.4 other
3.8 list, observe and service mechanical systems on a given vehicle

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
5.2 create a connection between a personal inventory and occupational choices

COURSE MEC1150: RIDE & CONTROL SYSTEMS

Level: Introductory

Prerequisite: None

Description: Students develop a basic knowledge of ride and control systems associated with vehicles.

Parameters: Access to a floor jack, safety stands, a suspension/steering system and related resources.

Outcomes: The student will:

1. **demonstrate the safe use of tools and follow established laboratory procedures**
   - 1.1 demonstrate knowledge of and follow established safety procedures
2. **describe the purpose, operation and interdependent nature of ride and control systems**
   - 2.1 locate and identify the components that are used to provide:
     - 2.1.1 stopping action
     - 2.1.2 directional control
     - 2.1.3 rolling action
     - 2.1.4 stabilization
     - 2.1.5 cushioning
     - 2.1.6 other actions
   - 2.2 describe methods of directional control on land, sea and air vehicles/crafts
   - 2.3 describe the method of steering used by most wheeled vehicles
   - 2.4 explain the purpose of the parts of a conventional steering system; e.g., steering gear, tie rod end, idler arm, pitman arm and steering knuckle
   - 2.5 list the parts of a steering system that are subject to wearing or bending
   - 2.6 identify and describe the action of the following types of braking systems and possible application:
     - 2.6.1 mechanical
     - 2.6.2 hydraulic
     - 2.6.3 electric
     - 2.6.4 air
     - 2.6.5 other
   - 2.7 explain the difference between the braking action of a disc brake and the breaking action of a drum brake
   - 2.8 determine how tires and tracks vary according to:
     - 2.8.1 road or terrain use
     - 2.8.2 seasonal use
     - 2.8.3 methods of construction
   - 2.9 show how to examine the wear pattern on a tire to determine whether it has been:
     - 2.9.1 overinflated or underinflated
     - 2.9.2 improperly aligned
     - 2.9.3 subject to suspension faults
     - 2.9.4 balanced improperly

3. inspect and service ride and control systems

- 3.1 check and complete a tire repair
- 3.2 complete a tire balance
- 3.3 identify tire wear problems
- 3.4 inspect and repack wheel bearing
- 3.5 list and identify the parts of a braking system that are subject to wearing, seizing or leaking

4. demonstrate basic competencies

- 4.1 demonstrate fundamental skills to:
  - 4.1.1 communicate
  - 4.1.2 manage information
  - 4.1.3 use numbers
  - 4.1.4 think and solve problems
- 4.2 demonstrate personal management skills to:
  - 4.2.1 demonstrate positive attitudes and behaviours
  - 4.2.2 be responsible
  - 4.2.3 be adaptable
  - 4.2.4 learn continuously
  - 4.2.5 work safely
- 4.3 demonstrate teamwork skills to:
  - 4.3.1 work with others
  - 4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

- 5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
- 5.2 create a connection between a personal inventory and occupational choices

COURSE MEC1160: STRUCTURES & MATERIALS

Level: Introductory

Prerequisite: None

Description: Students identify the types of materials and components used in vehicle construction.

Parameters: Access to a vehicle, hand tools, fasteners, materials and related resources.

Outcomes: The student will:

1. **demonstrate the safe use of tools and follow established laboratory procedures**
   - 1.1 state health and environmental issues related to the replacement and repair of coated surfaces
   - 1.2 state how hazardous materials are handled and disposed of
2. **explain the relationship between the function of a vehicle and the materials used in its construction**
   - 2.1 outline the historical development of materials used in transportation vehicles
   - 2.2 identify what parts of a vehicle are recyclable
   - 2.3 cite examples of initiatives that will increase the percentage of parts that can be recycled
   - 2.4 list ways government regulations have altered the design and construction of vehicles
   - 2.5 identify design features that are tied more closely to consumer taste than function
   - 2.6 identify and discuss the factors that have contributed to the use and development of new structural materials
   - 2.7 identify the factors used to select a material for a given function
   - 2.8 indicate how design and construction of a vehicle is affected by the medium (land, sea, air, space) in which it operates
   - 2.9 identify the monolith and composite materials used in a modern vehicle
3. **examine and identify the basic parts and materials used in vehicle construction**
   - 3.1 describe the most appropriate methods of identifying the type of materials used in a part or structure
   - 3.2 describe the action of a coil spring when subject to rapid loading
   - 3.3 describe how to:
     - 3.3.1 reduce the weight of a vehicle
     - 3.3.2 reduce drag
     - 3.3.3 increase passenger safety
     - 3.3.4 increase longevity of structural parts
     - 3.3.5 improve passenger comfort and space
   - 3.4 demonstrate knowledge of common types of fasteners used including:
     - 3.4.1 studs, bolts, screws
     - 3.4.2 nuts
     - 3.4.3 rivets
     - 3.4.4 clips
     - 3.4.5 clamps

3.5 identify what structural coatings are used to:
    3.5.1 protect against corrosion
    3.5.2 add to the appearance
    3.5.3 reduce effects of the sun's radiation
    3.5.4 reduce noise

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
5.2 create a connection between a personal inventory and occupational choices

COURSE MEC1165: MECHANICS WELDING FUNDAMENTALS

Level: Introductory

Prerequisite: MEC1015: Mechanics Tools & Materials

Description: Students perform metal heating and cutting operations safely using oxyacetylene equipment, and perform non-structural welding using Gas Metal Arc Welding (GMAW) equipment.

Parameters: Access to a materials work centre, complete with oxyacetylene heating and cutting equipment, GMAW equipment, fabrication facilities, and to instruction from an individual with formal specialized training in oxyacetylene and GMAW.

Outcomes: The student will:

Using Oxyacetylene Equipment:

1. **identify and demonstrate the use of personal protective equipment**
   - 1.1 use an appropriate fire extinguisher in the event of fire
   - 1.2 use eye protection
   - 1.3 use protective clothing
   - 1.4 use protective footwear
   - 1.5 use proper ventilation
   - 1.6 follow proper safety procedures
2. **describe the characteristics and safe handling procedures for oxygen and acetylene**
   - 2.1 identify and describe the properties of oxygen gas
   - 2.2 identify and describe the make-up of an oxygen cylinder/bottle including valves and safety devices
   - 2.3 identify and describe the properties of acetylene gas
   - 2.4 identify and describe the make-up of an acetylene cylinder/bottle including valves and safety devices
   - 2.5 correctly follow cylinder transport procedures
   - 2.6 correctly mount cylinder and attach regulator and hoses
3. **demonstrate safe handling procedures for regulators and hoses**
   - 3.1 identify and describe regulators and torches including:
     - 3.1.1 purpose
     - 3.1.2 regulator types
     - 3.1.3 torch types
     - 3.1.4 identification, hoses
     - 3.1.5 flashback arrestors
     - 3.1.6 torch check valves–reverse flow check valves
     - 3.1.7 torch types and parts
4. **demonstrate the safe use, care and maintenance of torches and tips**
   - 4.1 identify and describe conditions that lead to backfires and flashbacks
   - 4.2 identify and describe flame types and functions
   - 4.3 demonstrate:
     - 4.3.1 purge and leak tests
     - 4.3.2 start-up and shut-down procedures

4.4 demonstrate:
- 4.4.1 correct heating tip selection
- 4.4.2 check and clean tips and torches
- 4.4.3 install tips
- 4.4.4 balance regulators and adjust torch flame
- 4.4.5 heat metal
- 4.4.6 shut down equipment

5. perform basic cutting operations
- 5.1 fit, light and adjust cutting torch
- 5.2 maintain cutting torch and tips
- 5.3 select correct tip for planned activity
- 5.4 cut holes in metal plate
- 5.5 cut and remove rivets and bolts
- 5.6 shut down cutting torch

Using GMAW Welding Equipment:

6. identify and demonstrate the use of personal protective equipment
- 6.1 identify the appropriate fire extinguisher in the event of a fire
- 6.2 use eye protection
- 6.3 use protective clothing
- 6.4 use protective footwear
- 6.5 use proper ventilation
- 6.6 follow proper safety procedures

7. describe the principles of operation of GMAW
- 7.1 identify and describe:
  - 7.1.1 principles of operation
  - 7.1.2 metal transfer

8. identify the components of a basic GMAW set-up
- 8.1 apply safe work practices and procedures to:
  - 8.1.1 select and use appropriate personal protective equipment
  - 8.1.2 maintain a clean and tidy work station
  - 8.1.3 demonstrate safe tool/material handling and storage techniques
- 8.2 for a given type of weld and/or weldment, select the appropriate:
  - 8.2.1 wire type, size and feed rate
  - 8.2.2 current
  - 8.2.3 shielding gas type and flow rate
- 8.3 prepare and clean all surfaces to be welded
- 8.4 properly position metal for welding
- 8.5 identify precautions to take against electric shock, toxic fumes and radiant energy associated with GMAW

9. diagnose and demonstrate corrective measures for malfunctioning GMAW equipment
- 9.1 describe and demonstrate the maintenance required for wire drive systems and gun assemblies

10. demonstrate basic welding technique
- 10.1 demonstrate tack weld components to gain competency
- 10.2 make light-gauge fillet welds in the flat and horizontal position and down-hand fillet welds on light gauge tubing

11. demonstrate basic competencies

- 11.1 demonstrate fundamental skills to:
  - 11.1.1 communicate
  - 11.1.2 manage information
  - 11.1.3 use numbers
  - 11.1.4 think and solve problems
- 11.2 demonstrate personal management skills to:
  - 11.2.1 demonstrate positive attitudes and behaviours
  - 11.2.2 be responsible
  - 11.2.3 be adaptable
  - 11.2.4 learn continuously
  - 11.2.5 work safely
- 11.3 demonstrate teamwork skills to:
  - 11.3.1 work with others
  - 11.3.2 participate in projects and tasks

12. make personal connections to the cluster content and processes to inform possible pathway choices

- 12.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
- 12.2 create a connection between a personal inventory and occupational choices

COURSE MEC1170: METAL FORMING & FINISHING

Level: Introductory

Prerequisite: MEC1160: Structures & Materials

Description: Students repair and re-form damaged metal panels.

Parameters: Access to oxy-fuel welding equipment, basic autobody hand/power tools, basic metal refinishing material, resources and to instruction from an individual with formal specialized training.

Supporting Course: FAB1040: Oxyacetylene Welding

Outcomes: The student will:

1. **demonstrate safe work practices when metal forming and finishing and follow established laboratory procedures**
   - 1.1 demonstrate safe practices in relation to:
     - 1.1.1 personal protective equipment/clothes
     - 1.1.2 use of impact tools, drills, grinders, cutters, sheet metal brake and shear
     - 1.1.3 safe use of oxyacetylene and Gas Metal Arc Welding (GMAW) equipment
     - 1.1.4 hazards of body fillers
2. **describe the effects of physical damage caused by distortion and corrosion on sheet metal components**
   - 2.1 identify properties of:
     - 2.1.1 low carbon steels
     - 2.1.2 high strength steels
3. **apply metal forming and finishing skills to repair minor panel damage**
   - 3.1 list tools and equipment available to shape and finish sheet metal
   - 3.2 identify the process required for specific types of metal shaping
   - 3.3 identify processes for metal working and repairing small dents using:
     - 3.3.1 pry bar
     - 3.3.2 pulling tools
     - 3.3.3 hammering techniques
   - 3.4 describe possible methods of small rust out repair
   - 3.5 describe the best method of small rust out repair
   - 3.6 identify various plastic filler materials available
   - 3.7 describe the suitable type of plastic fillers to be used
   - 3.8 complete a small rust out repair
   - 3.9 demonstrate how to:
     - 3.9.1 hammer and dolly metal panel to smooth contour
     - 3.9.2 pick, file and grind panel to desired finish
     - 3.9.3 prepare the surface for filler application
     - 3.9.4 apply plastic fillers and refinish

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences

5.2 create a connection between a personal inventory and occupational choices

COURSE MEC1190: SURFACE PREPARATION 1

Level: Introductory

Prerequisite: None

Description: Students assess the state of a painted surface and use appropriate restoration procedures.

Parameters: Access to painting facilities, surface preparation tools/materials and related resources.

Outcomes: The student will:

1. **demonstrate safe work practices for surface preparation and follow established laboratory procedures**
   - 1.1 demonstrate safe practices in relation to:
     - 1.1.1 abrasive dust
     - 1.1.2 chemicals/fumes
2. **identify products, equipment and procedures associated with surface preparation**
   - 2.1 identify and describe problem conditions in painted surfaces
   - 2.2 list types of equipment/tools used in surface preparation processes
   - 2.3 list types of abrasives used in surface preparation
   - 2.4 identify alternative methods of surface preparation; e.g., chemical stripping, blasting
   - 2.5 demonstrate knowledge of types, purpose and methods of applying undercoats
   - 2.6 identify types and uses of putties
   - 2.7 identify methods of masking
   - 2.8 list equipment used in masking
3. **prepare and perform a surface preparation**
   - 3.1 explain and demonstrate methods of sanding
   - 3.2 use appropriate methods of surface preparation
   - 3.3 identify and apply appropriate metal conditioner
   - 3.4 demonstrate how to mask a surface prior to painting
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems
   - 4.2 demonstrate personal management skills to:
     - 4.2.1 demonstrate positive attitudes and behaviours
     - 4.2.2 be responsible
     - 4.2.3 be adaptable
     - 4.2.4 learn continuously
     - 4.2.5 work safely
   - 4.3 demonstrate teamwork skills to:
     - 4.3.1 work with others
     - 4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences

5.2 create a connection between a personal inventory and occupational choices

COURSE MEC1910: MEC PROJECT A

Level: Introductory

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Introductory project courses must connect with a minimum of two CTS courses, one of which must be at the introductory level and be in the same occupational area as the project course. The other CTS course(s) can be either at the same level or at the intermediate level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
   - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
   - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
   - 2.1 identify the project and/or performance by:
     - 2.1.1 preparing a plan
     - 2.1.2 clarifying the purposes
     - 2.1.3 defining the deliverables
     - 2.1.4 specifying time lines
     - 2.1.5 explaining terminology, tools and processes
     - 2.1.6 defining resources; e.g., materials, costs, staffing
   - 2.2 identify and comply with all related health and safety standards
   - 2.3 define assessment standards (indicators for success)
   - 2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
   - 3.1 complete the project and/or performance as outlined
   - 3.2 monitor the project and/or performance and make necessary adjustments
   - 3.3 present the project and/or performance, indicating the:
     - 3.3.1 outcomes attained
     - 3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices

5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
5.2 create a connection between a personal inventory and occupational choices

COURSE MEC2010: VEHICLE DETAILING

Level: Intermediate

Prerequisite: None

Description: Students develop the skills required to restore and enhance the exterior finishes of a vehicle.

Parameters: Access to commercially available products and related resources.

Outcomes: The student will:

1. **state personal and environmental hazards associated with the use of cleaning and waxing agents**
   - 1.1 demonstrate knowledge of and follow safety rules and procedures in the handling of dangerous cleaning agents
   - 1.2 demonstrate safe handling and application of volatile cleaners used for engine cleaning
   - 1.3 demonstrate knowledge of and follow procedures outlined to prevent damage to electrical or other parts when engine cleaning
   - 1.4 identify hazards that are present; e.g., acid powder
2. **identify and describe materials available to enhance the appearance of a vehicle**
   - 2.1 identify surface flaws and solutions that could be used other than spray painting
   - 2.2 explain the value of using waxes to treat painted surfaces; e.g., longevity, monetary implications
3. **demonstrate the correct cleaning and treatment of engine parts and exterior finishes including paint, glass, vinyl and rubber surfaces**
   - 3.1 use materials available to complete an engine clean and, if possible, apply enhancing materials such as paints or coatings
   - 3.2 describe the value of maintaining a clean and neat engine compartment
   - 3.3 identify and demonstrate the correct procedures when using cleaning and polishing/treatment agents on various surfaces
   - 3.4 explain the value of using methods to enhance the appearance of a vehicle without painting
4. **install a trim or accessory part according to standard practice**
   - 4.1 identify common types of trim fasteners and tools
   - 4.2 list the precautions needed to prevent damage to trim or adjacent surfaces when removing and replacing trim parts
   - 4.3 show knowledge of and demonstrate the procedures and tools used to remove and replace trim parts
   - 4.4 demonstrate the application of decals, pinstriping and/or moulding as a method of enhancing vehicle appearance and value
   - 4.5 demonstrate the ability to follow installation instructions by completing an accessory installation project
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment
6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2020: VEHICLE MAINTENANCE

Level: Intermediate

Prerequisite: MEC1020: Vehicle Service & Care

Description: Students perform the basic service requirements necessary to ensure adequate maintenance of a motor vehicle.

Parameters: Access to vehicles, specialty tools, hand tools and related resources.

Note: Customer work is to be checked by a certified technician when work is performed on brakes, steering and suspension.

Outcomes: The student will:

1. **demonstrate safe work practices when working with vehicles and follow established laboratory procedures**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
2. **identify vehicle service requirements as per manufacturer's recommendations**
   - 2.1 identify the service requirements for a specific motor vehicle considering the odometer reading, conditions of operation and service history
3. **conduct a motor vehicle inspection considering the age of the vehicle, distance travelled, service conditions and history**
   - 3.1 check tire condition
   - 3.2 mount and balance tires
   - 3.3 rotate tires to maximize wear life
   - 3.4 inspect steering and suspension system components
   - 3.5 inspect, repack and adjust wheel bearing
   - 3.6 lubricate steering and suspension system joints
   - 3.7 replenish fluids in power steering pump
   - 3.8 inspect and top-up brake fluid reservoir
   - 3.9 inspect and assess the wear characteristics of disc brake and drum brake components
   - 3.10 lubricate parking brake linkages
   - 3.11 inspect and service battery and battery clamps; renew clamps, if required
   - 3.12 adjust alternator belt tension, if necessary
   - 3.13 check the operation of all lights and replace bulbs, if required
   - 3.14 inspect fuse panel and renew inoperative fuses
   - 3.15 use a multimeter to test a charging system
   - 3.16 lubricate hinges on all opening panels and weatherstrips
   - 3.17 lubricate locks or lock plates, as required
   - 3.18 inspect and change windshield wiper blades, if necessary
   - 3.19 inspect for loose trim or mouldings
   - 3.20 identify and describe the condition of the camshaft timing belt or chain and recommend the appropriate service
   - 3.21 evaluate brake system fluid integrity and brake pedal feel and identify repair requirements

4. service and repair a motor vehicle according to vehicle condition and service schedule

4.1 demonstrate how to:

- 4.1.1 inspect an engine for oil leaks
- 4.1.2 renew engine gaskets or seals, where necessary
- 4.1.3 change engine oil and filter
- 4.1.4 service Positive Crankcase Ventilation (PCV) valve and breather
- 4.1.5 inspect the condition of coolant, hoses, belts, fan and radiator; adjust belts, if required
- 4.1.6 change or recondition the engine coolant and flush the cooling system, if required
- 4.1.7 pressure test the cooling system
- 4.1.8 replace the thermostat, if necessary
- 4.1.9 locate and inspect the fuel filter; replace, if required
- 4.1.10 replace the air filter, if required
- 4.1.11 inspect and service throttle linkage
- 4.1.12 inspect manifolds, pipes, catalytic converter, muffler and hangers for structural integrity; repair, as required
- 4.1.13 inspect and service or replace spark plugs, distributor cap and rotor, and replace spark plug wires and boots, as required by the service schedule
- 4.1.14 inspect and replace fuel purge canister filter, if required
- 4.1.15 inspect and replace fluids, as required, in transmissions, transaxle transfer cases and differential assemblies
- 4.1.16 inspect and recommend service for constant velocity joints, seals, drive shaft, drive axles and U-joints

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:

- 5.1.1 communicate
- 5.1.2 manage information
- 5.1.3 use numbers
- 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:

- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:

- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment

6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2030: LUBRICATION & COOLING

Level: Intermediate

Prerequisite: MEC1040: Engine Fundamentals

Description: Students diagnose, maintain and service the lubrication and cooling systems of a typical four-cycle gasoline engine.

Parameters: Access to a pressure tester, hand tools and related resources.

Outcomes: The student will:

1. **demonstrate safe work practices when working with vehicle engine fluids**
   - 1.1 identify the hazards associated with ethylene glycol
   - 1.2 demonstrate knowledge of and follow all safety procedures associated with hot fluids and fluids under pressure
   - 1.3 collect and dispose of all hazardous fluids in the appropriate manner
   - 1.4 remove all spills from work area
2. **identify and describe functions and operations of engine cooling and lubrication system components**
   - 2.1 identify the multiple tasks performed by the lubrication system
   - 2.2 describe the properties of engine oils intended for use in a late model engine
   - 2.3 interpret the meaning of the American Petroleum Institute (API) and Society of Automotive Engineers (SAE) symbols and viscosity numbers used on oil containers
   - 2.4 describe the design and operation of:
     - 2.4.1 a gear and rotor-type oil pump
     - 2.4.2 a pressure regulator or relief valve
     - 2.4.3 an oil pressure sensor gauge or indicator
     - 2.4.4 an oil level and change indicator
   - 2.5 identify possible causes of low/high oil pressure and high levels of oil consumption under normal operating conditions
   - 2.6 explain the function of the cooling system
   - 2.7 describe the relationship between the percentage of antifreeze and water to the coolant's freezing and boiling points
   - 2.8 identify the most appropriate percentage of antifreeze to meet local conditions
   - 2.9 describe the design and operation of a:
     - 2.9.1 radiator and cap
     - 2.9.2 fan
     - 2.9.3 thermostat
     - 2.9.4 hose
     - 2.9.5 water pump
     - 2.9.6 recovery tank
     - 2.9.7 block heater
   - 2.10 identify possible causes for engine overheating or running cold under normal operating conditions

3. diagnose and correct lubrication and cooling system faults

3.1 demonstrate how to:

- 3.1.1 inspect engine for oil leaks owing to gasket/seal failure
- 3.1.2 replace seal/gaskets, if necessary
- 3.1.3 disassemble and inspect a gear or rotor pump for pitting and galling or abnormal wear
- 3.1.4 test oil pressure sensor and gauge/light circuit; service, if necessary
- 3.1.5 test temperature sensing system; service, if necessary
- 3.1.6 inspect hoses for cracks, soft spots and leaks; replace, if necessary
- 3.1.7 test thermostat; replace, if necessary
- 3.1.8 inspect water pump for leaks and bearing condition
- 3.1.9 inspect radiator fan
- 3.1.10 inspect radiator for leaks and blockages; replace, if necessary
- 3.1.11 check condition and tension of fan belt; replace, if necessary

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:

- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:

- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:

- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment

5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2040: FUEL & EXHAUST SYSTEMS

Level: Intermediate

Prerequisite: MEC1040: Engine Fundamentals

Description: Students diagnose, maintain and service the fuel and exhaust system of a typical four-cycle gasoline engine.

Parameters: Access to a ventilated area, a fuel pump vacuum/pressure tester and related resources, and to instruction from a certified technician when working on a customer vehicle.

Outcomes: The student will:

1. demonstrate safe work practices when working with volatile liquids and combustible gases
- 1.1 demonstrate knowledge of and follow all safety procedures associated with volatile liquids and exhaust gases
- 1.2 demonstrate how to:
  - 1.2.1 store fuels and solvents in the appropriate manner
  - 1.2.2 maintain proper venting and air supply in the work area

2. identify and describe functions and operations of engine fuel and exhaust system components
- 2.1 describe the chemical composition of gasoline and the effects complete and incomplete combustion have on the environment and engine performance
- 2.2 describe the characteristics of a quality gasoline in relation to its volatility and octane rating
- 2.3 identify measures that are taken to:
  - 2.3.1 prevent the formation of gum deposits
  - 2.3.2 prevent the oxidation of metal parts
  - 2.3.3 retard icing
  - 2.3.4 aid in the identification of fuel types and grades
- 2.4 describe the factors that affect combustion including:
  - 2.4.1 spark plug location
  - 2.4.2 combustion chamber size and shape
  - 2.4.3 compression ratio
  - 2.4.4 valve and combustion chamber design
  - 2.4.5 spark timing, duration and intensity
  - 2.4.6 air temperature and fuel ratio
  - 2.4.7 manifold pressures
  - 2.4.8 valve timing, valve lift and duration
- 2.5 identify and describe the function of the major fuel system components
- 2.6 explain the difference between a carburetor and a fuel injected system
- 2.7 identify the common problems associated with carburetors and fuel injected systems
- 2.8 locate and describe the function of the major exhaust system components

3. diagnose and correct fuel and exhaust system faults

- 3.1 inspect fuel filter/strainer and replace, if necessary
- 3.2 clean and adjust a typical carburetor on and off an engine
- 3.3 visually inspect and test a typical fuel injection system
- 3.4 test fuel pump pressure and capacity; repair or replace, if necessary
- 3.5 visually inspect and test for exhaust leaks or blockages; replace converters, pipes and mufflers, if necessary

4. demonstrate basic competencies

- 4.1 demonstrate fundamental skills to:
  - 4.1.1 communicate
  - 4.1.2 manage information
  - 4.1.3 use numbers
  - 4.1.4 think and solve problems
- 4.2 demonstrate personal management skills to:
  - 4.2.1 demonstrate positive attitudes and behaviours
  - 4.2.2 be responsible
  - 4.2.3 be adaptable
  - 4.2.4 learn continuously
  - 4.2.5 work safely
- 4.3 demonstrate teamwork skills to:
  - 4.3.1 work with others
  - 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

- 5.1 recognize and then analyze the opportunities and barriers in the immediate environment
- 5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2050: ALTERNATIVE FUEL ENGINES

Level: Intermediate

Prerequisite: None

Description: Students determine alternative fuels used to power motor vehicles.

Parameters: Access to related resources and basic hand tools.

Outcomes: The student will:

1. **demonstrate safe work practices when working with alternative fuel vehicles**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 state how alternative fuels affect the environment
2. **determine the type of fuel that is best suited to a particular use and type of vehicle**
   - 2.1 identify the typical alternative fuels; e.g., diesel, propane, methanol, natural gas, hydrogen
   - 2.2 compare the heat-producing characteristics of each fuel
   - 2.3 identify resources and methods of marketing different types of fuel
   - 2.4 identify ways in which fuels are stored
   - 2.5 describe the engine design modifications that are required to operate on:
     - 2.5.1 diesel
     - 2.5.2 propane
     - 2.5.3 methanol
     - 2.5.4 other
   - 2.6 describe the advantages of using an alternative fuel by considering:
     - 2.6.1 fuel cost
     - 2.6.2 availability
     - 2.6.3 performance
     - 2.6.4 engine life
     - 2.6.5 environmental impact
3. **service an alternative fuel vehicle, recognizing its unique maintenance requirements**
   - 3.1 describe the specific service requirement for an alternative fuel engine
   - 3.2 complete a service and maintenance task according to the manufacturer's recommendations; e.g., change oil and fuel filters, engine lubricant, glow plugs and heaters
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems
   - 4.2 demonstrate personal management skills to:
     - 4.2.1 demonstrate positive attitudes and behaviours
     - 4.2.2 be responsible
     - 4.2.3 be adaptable
     - 4.2.4 learn continuously
     - 4.2.5 work safely
   - 4.3 demonstrate teamwork skills to:
     - 4.3.1 work with others
     - 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment

5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2060: IGNITION SYSTEMS

Level: Intermediate

Prerequisite: None

Description: Students identify the basic components and parts of ignition systems used on internal combustion engines, and service and repair an ignition system.

Parameters: Access to a multimeter, a timing light, hand tools and related resources.

Supporting Courses: MEC1040: Engine Fundamentals
MEC1090: Electrical Fundamentals

Outcomes: The student will:

1. **follow electrical safety guidelines by accurately interpreting and using instruction manuals**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 describe hazards involved when working with high voltages and currents
2. **explain how a timed high voltage spark is achieved in magneto, point and electronic ignition systems**
   - 2.1 list and describe the three common types of ignition systems
   - 2.2 name the parts of the following ignition systems:
     - 2.2.1 magneto
     - 2.2.2 point type
     - 2.2.3 electronic
     - 2.2.4 computer-coil (distributorless)
3. **recognize the drivability symptoms and use visual and instrument checks to diagnose ignition system faults**
   - 3.1 identify and describe symptoms produced by a typical ignition failure including:
     - 3.1.1 loose connection(s)
     - 3.1.2 faulty spark plug(s)
     - 3.1.3 faulty coil or wire
     - 3.1.4 bad distributor cap or rotor
     - 3.1.5 faulty points
     - 3.1.6 faulty pick-up coil
4. **service and repair an ignition system**
   - 4.1 test the following:
     - 4.1.1 primary circuit voltage drop
     - 4.1.2 high tension lead resistance
     - 4.1.3 ignition coil
     - 4.1.4 ignition cap
     - 4.1.5 pick-up coil
     - 4.1.6 distributor points and condensor
     - 4.1.7 advance mechanisms
   - 4.2 show how to remove and analyze a spark plug to determine how well the engine is operating; e.g., oil consumption, fuel/air ratio and service/repair, if required
   - 4.3 lubricate distributor
   - 4.4 clean and tighten electrical leads and connections

4.5 complete the following according to the manufacturer's specifications:
- 4.5.1 clean gap and/or replace with new spark plugs
- 4.5.2 clean and/or replace with new contact points
- 4.5.3 adjust contact points and pick-up coil gap
- 4.5.4 adjust/repair advance mechanisms
- 4.5.5 set ignition timing statically and check with a timing light

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:
- 5.1.1 communicate
- 5.1.2 manage information
- 5.1.3 use numbers
- 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:
- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment

6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2070: EMISSION CONTROLS

Level: Intermediate

Prerequisite: None

Description: Students describe the importance of controlling emissions and the technology applied to vehicles to meet prescribed standards.

Parameters: Access to specialized equipment and resources related to analyzing and testing emission control.

Supporting Courses: MEC2030: Lubrication & Cooling
MEC2040: Fuel & Exhaust Systems
MEC2060: Ignition Systems

Outcomes: The student will:

1. **demonstrate safe work practices when working with emission control systems**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 describe effect of vehicle emissions on the environment and specifically on human life
2. **list and describe vehicle pollutants and their effects on the environment**
   - 2.1 list types and where vehicle pollutants are created
   - 2.2 explain how these pollutants are created
   - 2.3 identify regulations that dictate maximum pollutant levels
3. **describe types and characteristics of pre- and post-combustion emission systems**
   - 3.1 identify and demonstrate knowledge of the operation of the following pre-combustion control systems:
     - 3.1.1 crankcase ventilation system
     - 3.1.2 exhaust gas recirculation system
     - 3.1.3 ignition spark control systems
     - 3.1.4 computerized engine controls
     - 3.1.5 evaporative control systems
     - 3.1.6 engine design modifications; i.e., combustion chamber, piston, cylinder head, manifold and air induction design
4. **identify emission control components**
   - 4.1 identify and demonstrate knowledge of the operation of the following post-combustion control systems on several different types of vehicles:
     - 4.1.1 air injection system
     - 4.1.2 air aspirator system
     - 4.1.3 catalytic converters
5. **diagnose and service emission control systems**
   - 5.1 demonstrate how to:
     - 5.1.1 check and service positive crankcase ventilation system
     - 5.1.2 check and service evaporative control system
     - 5.1.3 check and service air injector system
     - 5.1.4 check and service exhaust gas recirculation system
     - 5.1.5 check catalytic converter
     - 5.1.6 check and adjust spark control system

5.1.7 check computerized engine controls
5.1.8 using exhaust gas analyzer, if available, check emissions for a given vehicle

6. demonstrate basic competencies

6.1 demonstrate fundamental skills to:
- 6.1.1 communicate
- 6.1.2 manage information
- 6.1.3 use numbers
- 6.1.4 think and solve problems

6.2 demonstrate personal management skills to:
- 6.2.1 demonstrate positive attitudes and behaviours
- 6.2.2 be responsible
- 6.2.3 be adaptable
- 6.2.4 learn continuously
- 6.2.5 work safely

6.3 demonstrate teamwork skills to:
- 6.3.1 work with others
- 6.3.2 participate in projects and tasks

7. identify possible life roles related to the skills and content of this cluster

7.1 recognize and then analyze the opportunities and barriers in the immediate environment

7.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2090: ELECTRICAL COMPONENTS

Level: Intermediate

Prerequisite: MEC1090: Electrical Fundamentals

Description: Students identify and describe the basic use and testing of the electrical components of a typical motor vehicle.

Parameters: Access to a voltmeter, ohmmeter, ammeter, alternator, starter and related resources.

Outcomes: The student will:

1. **demonstrate safe work practices when working with electrical components**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures with respect to electrical hazards, including:
     - 1.1.1 electrical shocks
     - 1.1.2 electrical burns
   - 1.2 demonstrate how to avoid sparks and grounding
   - 1.3 explain electrical polarity
2. **describe the function and operation of a vehicle's electrical systems and components**
   - 2.1 locate the major electrical/electronic systems in a motor vehicle; e.g., lighting, charging, starting
   - 2.2 explain the operation and function of each of the electrical/electronic systems
   - 2.3 show how electrical/electronic systems interact with other vehicle systems; e.g., suspension and braking systems
   - 2.4 identify and explain the purpose and basic component parts of charging, starting and lighting systems
   - 2.5 identify and draw the symbols for common electrical components
   - 2.6 identify and describe the ratings that are given to electrical components; e.g., resistance, voltage, amperage and power rating
3. **identify electrical faults, by using standard diagnostic and testing procedures**
   - 3.1 identify and describe the purpose and functions of a:
     - 3.1.1 voltmeter
     - 3.1.2 ohmmeter
     - 3.1.3 ammeter
     - 3.1.4 multimeter
     - 3.1.5 load tester
     - 3.1.6 tack dwell meter
     - 3.1.7 growler
   - 3.2 calibrate correctly, connect accurately and read the appropriate test equipment to determine:
     - 3.2.1 open and closed circuit
     - 3.2.2 load voltage and drop
     - 3.2.3 current draw
     - 3.2.4 component resistance
4. **test and service electrical components**
   - 4.1 identify and correct faults associated with electrical components and instruments
   - 4.2 overhaul a starter motor assembly
   - 4.3 overhaul an alternator

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:
- 5.1.1 communicate
- 5.1.2 manage information
- 5.1.3 use numbers
- 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:
- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment

6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2100: POWER ASSIST ACCESSORIES

Level: Intermediate

Prerequisite: MEC1110: Pneumatics & Hydraulics

Description: Students identify and explain the function of components and parts of power assist accessories.

Parameters: Access to a multimeter, power assist accessories and related resources.

Note: Customer work must be checked by certified technician.

Supporting Course: MEC1090: Electrical Fundamentals

Outcomes: The student will:

1. **demonstrate safe work practices when working on power assist accessories**
   - 1.1 demonstrate established laboratory safety procedures
   - 1.2 demonstrate practices that prevent damage to components
2. **list components and state functions of power assist accessories**
   - 2.1 describe the types and basic functions of power assist accessories found on vehicles
   - 2.2 compare power assist accessories to the mechanical systems they have replaced
   - 2.3 evaluate current power assist accessories as a means of forecasting types of power assist accessories that may be used in future vehicles
3. **describe and check major components, of power assist accessories**
   - 3.1 list the parts of selected power assist accessories
   - 3.2 describe the function of the major parts of selected power assist accessories
   - 3.3 trace the power path of selected power assist accessories
4. **service and repair power assist accessories**
   - 4.1 demonstrate how to use shop manuals to diagnose power assist accessory faults specific to power assist accessories
   - 4.2 identify problems and faults in power assist accessories systems
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems
   - 5.2 demonstrate personal management skills to:
     - 5.2.1 demonstrate positive attitudes and behaviours
     - 5.2.2 be responsible
     - 5.2.3 be adaptable
     - 5.2.4 learn continuously
     - 5.2.5 work safely
   - 5.3 demonstrate teamwork skills to:
     - 5.3.1 work with others
     - 5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment

6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2110: BRAKING SYSTEMS

Level: Intermediate

Prerequisite: MEC1110: Pneumatics & Hydraulics

Description: Students develop the necessary knowledge, skills and attitudes to diagnose, service and maintain a braking system according to accepted trade practices.

Parameters: Access to specialized brake tools and related resources.

Note: Customer work must be supervised by certified technician.

Outcomes: The student will:

1. **demonstrate safe work practices when working on brakes**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 demonstrate proper disposal of break dust
2. **identify brake design and components, and parking brake systems**
   - 2.1 identify the parts of a hydraulic brake drum system
   - 2.2 compare the operating principles of duo-servo and non-servo brake systems
   - 2.3 identify the parts of a disc brake system
   - 2.4 compare the operating principles of fixed, floating and sliding calliper braking systems
   - 2.5 describe the operation of a combined disc and drum system
   - 2.6 identify the parts of a parking brake system
   - 2.7 compare the operating principles of a parking brake system on disc and drum brake applications
3. **inspect and analyze disc and drum brake systems**
   - 3.1 demonstrate how to:
     - 3.1.1 prepare a work order, using appropriate questioning to determine brake problems
     - 3.1.2 check the master cylinder fluid level
     - 3.1.3 inspect drum and disc brake linings for wear
     - 3.1.4 inspect drum and rotor for service
     - 3.1.5 inspect drum brake backing plate for service
     - 3.1.6 inspect drum brake spring and hardware for service
     - 3.1.7 adjust a parking brake cable
4. **interpret parts and service manuals to perform routine brake system service and maintenance**
   - 4.1 demonstrate how to:
     - 4.1.1 machine a brake drum and rotor according to the manufacturer's specifications
     - 4.1.2 remove and replace disc and drum brake shoes
     - 4.1.3 remove/replace and overhaul a master cylinder, wheel cylinder and calliper
     - 4.1.4 replace a flexible brake hose
     - 4.1.5 bleed and flush a brake system
     - 4.1.6 replace a parking brake cable
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment
6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2120: HYDRAULIC ACCESSORIES

Level: Intermediate

Prerequisite: MEC1110: Pneumatics & Hydraulics

Description: Students develop a basic knowledge of hydraulic components, applications and servicing techniques.

Parameters: Access to basic hand tools, hydraulic systems and related resources.

Outcomes The student will:

1. **demonstrate safe work practices when working with hydraulic systems**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 explain hazards associated with pressure and heat build-up in hydraulic systems
2. **describe the functions of hydraulic components in a hydraulic system**
   - 2.1 describe the properties of hydraulic fluids in relation to:
     - 2.1.1 viscosity
     - 2.1.2 lubricating ability
     - 2.1.3 resistance to oxidation
     - 2.1.4 corrosion prevention
   - 2.2 identify the common types of connecting lines/hoses, fitting and seals
   - 2.3 describe the internal parts of a reservoir and state the purpose of filters, strainers and breathers
   - 2.4 describe the construction and operation of:
     - 2.4.1 cylinders
     - 2.4.2 gear and vane motors
   - 2.5 describe the function of:
     - 2.5.1 check and pressure control valves
     - 2.5.2 two- and four-way valves
   - 2.6 describe the construction and operation of gear, vane and piston pumps
   - 2.7 explain why and when accumulators are used in a hydraulic system
3. **interpret parts and service manuals to provide appropriate maintenance and service procedures on a hydraulic system**
   - 3.1 identify and describe appropriate maintenance and service procedures on a hydraulic system
4. **service hydraulic components**
   - 4.1 demonstrate how to:
     - 4.1.1 check fluid levels in reservoirs
     - 4.1.2 clean strainers
     - 4.1.3 replace system filters with the approved parts
     - 4.1.4 check seals for leaks and replace, if required
     - 4.1.5 replace a defective hose, line and fitting
     - 4.1.6 replace the hydraulic fluid in a system
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment
6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2130: DRIVE LINE

Level: Intermediate

Prerequisite: MEC1130: Mechanical Systems

Description: Students identify the purpose, describe the operation and perform the servicing of a vehicle drive line.

Parameters: Access to drive line units, hand tools, specialized drive line tools and related resources.

Outcomes: The student will:

1. **demonstrate safe work practices when working with vehicle drive lines**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 identify potential back problems associated with lifting heavy objects
2. **identify the purpose and describe the function of the major drive line components**
   - 2.1 list and describe the function of component assemblies in a drive line
   - 2.2 identify the construction, design features, operation and function of common drive line components
   - 2.3 differentiate between the following:
     - 2.3.1 slip yokes
     - 2.3.2 fixed yokes
     - 2.3.3 conventional universal joints including:
       - 2.3.3.1 constant velocity (CV) joints
       - 2.3.3.2 drive shaft
3. **execute inspection, diagnostic, service and repair procedures on specific drive line components**
   - 3.1 inspect drive line components including:
     - 3.1.1 joints
     - 3.1.2 straps
     - 3.1.3 boots
     - 3.1.4 drive shafts/half shafts
     - 3.1.5 centre support bearings
     - 3.1.6 yokes
   - 3.2 repair the coupling joint or shaft, as required, to return it to serviceability according to manufacturer's specifications
   - 3.3 inspect the drive line components for alignment, wear and looseness
   - 3.4 identify the cause of noise or vibration and repair or recommend required repair
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment

5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2140: TRANSMISSIONS/TRANSAXLES

Level: Intermediate

Prerequisite: MEC2130: Drive Line

Description: Students perform inspection service and repair procedures on manual transmissions, transaxles and clutch assemblies.

Parameters: Access to pilot shafts, specialized manual transmission tools, presses, pullers and related resources, and clutch, transmission and transaxle units.

Outcomes: The student will:

1. **demonstrate safe work practices when working on transmissions and transaxles**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 identify back problems associated with lifting heavy objects
2. **identify parts and trace power flow through a clutch, manual transmission and differential and manual transaxle assembly**
   - 2.1 describe the operation of a clutch assembly, a manual transmission and a manual transaxle during various modes of vehicle operation
   - 2.2 describe the relationship that the clutch and manual gear box have to other parts of the drive line
   - 2.3 identify the parts of the assemblies, using the proper technical terms
   - 2.4 for each gear, identify the path of power through transmission or transaxle and compare the gear ratio of each power routing, as well as the direction of rotation
3. **inspect, diagnose, service and repair clutch, manual transmission or manual transaxle assemblies**
   - 3.1 demonstrate how to:
     - 3.1.1 check clutch pedal operation, travel and free play adjustment
     - 3.1.2 remove clutch inspection cover and check for wear to the clutch disc and pressure plate, as well as other visually available parts
     - 3.1.3 inspect clutch linkage for faults and/or wear
     - 3.1.4 inspect shifting linkages for any undue looseness or signs of wear
     - 3.1.5 check lubricant for level and type and recommended change interval
     - 3.1.6 inspect mounts, braces and isolator cushions for wear fatigue or damage
     - 3.1.7 inspect the assembly for leakage and note location and seal at fault
     - 3.1.8 prepare a repair cost estimate, prior to commencement of repairs, as identified during inspection or servicing
   - 3.2 formulate probable causes for typical problems that develop with clutches including:
     - 3.2.1 grabbing
     - 3.2.2 slipping
     - 3.2.3 failing to release
     - 3.2.4 noise when disengaged
     - 3.2.5 noise when engaging
   - 3.3 where possible, relate the hypothetical situation to a real vehicle condition
   - 3.4 formulate probable causes for typical problems that develop with manual gear boxes including:
     - 3.4.1 gears clashing
     - 3.4.2 hard shifting
     - 3.4.3 jumping out of gear

3.4.4 noises in specific gears
3.4.5 inability to engage gears
3.4.6 shifter noisy or loose
3.4.7 bearing noises

3.5 perform the clutch repairs, as identified and estimated to the teacher and agreed upon by the owner of the vehicle

AND/OR

3.6 remove and reinstall a clutch disc, pressure plate assembly, pilot bearing and throw-out bearing; check each part to confirm the continued serviceability of the assembly and clean each part before reassembly; adjust linkage to specified clearances

3.7 adjust clutch linkage for correct free play at pedal or, in the case of an automatic clutch adjuster, confirm the operation as being correct

3.8 follow through on agreed-upon transmission/transaxle repairs, identified and estimated to the teacher and the owner of the vehicle

AND/OR

3.9 disassemble, inspect and reassemble a three- or four-speed manual transmission with external linkage and constant mesh gearing

3.10 replace manual transmission lubricant with the specified type

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
4.1.1 communicate
4.1.2 manage information
4.1.3 use numbers
4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
4.2.1 demonstrate positive attitudes and behaviours
4.2.2 be responsible
4.2.3 be adaptable
4.2.4 learn continuously
4.2.5 work safely

4.3 demonstrate teamwork skills to:
4.3.1 work with others
4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment

5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2150: SUSPENSION SYSTEMS

Level: Intermediate

Prerequisite: MEC1150: Ride & Control Systems

Description: Students develop the knowledge, skills and attitudes necessary to service and maintain vehicle suspension systems.

Parameters: Access to suspension systems, specialized suspension tools and related resources.

Note: Customer work must be checked by certified technician.

Outcomes: The student will:

1. **demonstrate safe work practices when working on suspension systems**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures when working on suspension components
2. **identify the purpose and function of suspension parts**
   - 2.1 describe the basic types of front and rear suspensions used on motor vehicles; e.g., short, long arm suspension and MacPherson strut
   - 2.2 compare the advantages and disadvantages of using separate and integral frames in relation to suspension design, repair and servicing
   - 2.3 explain the advantage of using a:
     - 2.3.1 solid "I" beam
     - 2.3.2 split "I" beam
     - 2.3.3 independent front suspension and a:
       - 2.3.3.1 rigid suspension
       - 2.3.3.2 independent rear suspension
   - 2.4 explain why it is important to reduce the amount of unsprung weight
   - 2.5 list the positive and negative features of using coil, leaf, torsion, rubber biscuit and air springs
   - 2.6 explain the meaning of spring rate and travel
   - 2.7 list basic types and describe the operation of shock absorbers, mounting techniques and methods of testing
3. **identify worn or defective suspension parts**
   - 3.1 describe typical wheel bearing faults; e.g., bent cage, etching, overheating, worn seal
   - 3.2 repack a front or rear wheel bearing
   - 3.3 lubricate suspension joints, where necessary
   - 3.4 inspect suspension components for damage and wear
   - 3.5 explain how ball joints are checked for wear
4. **service a suspension system**
   - 4.1 remove and replace a:
     - 4.1.1 shock absorber
     - 4.1.2 coil spring
     - 4.1.3 ball joint
     - 4.1.4 strut
   - 4.2 identify the appropriate lifting and towing procedures relative to electronically controlled suspension systems

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:
- 5.1.1 communicate
- 5.1.2 manage information
- 5.1.3 use numbers
- 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:
- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment

6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2160: STEERING SYSTEMS

Level: Intermediate

Prerequisite: MEC1150: Ride & Control Systems

Description: Students develop the knowledge, skills and attitudes necessary to maintain a steering system.

Parameters: Access to steering systems, specialized steering tools and related resources.

Note: Customer work must be checked by certified technician.

Outcomes: The student will:

1. **demonstrate safe work practices when working on steering systems**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures when working on steering systems, and explain the importance of proper adjustments and torques
2. **identify different steering system designs and applications**
   - 2.1 identify common types of steering gears used to create the necessary mechanical advantages to overcome tire resistance; e.g., recirculating ball, rack and pinion
   - 2.2 identify and compare the operation of two or more steering boxes
   - 2.3 identify and compare the operation of common types of power steering pumps; e.g., roller, vane, slipper, gear
3. **diagnose problems related to manual and power steering systems**
   - 3.1 demonstrate how to:
     - 3.1.1 overhaul and adjust a recirculating ball and rack and pinion steering gear
     - 3.1.2 diagnose power steering problems including:
       - 3.1.2.1 pressure testing
       - 3.1.2.2 flow testing
       - 3.1.2.3 electrical tests
4. **service/repair a vehicle steering system**
   - 4.1 clean and inspect steering linkage for wear and replace, if necessary
   - 4.2 inspect steering joints, bushings and replace, if necessary
   - 4.3 inspect and service power steering components
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems
   - 5.2 demonstrate personal management skills to:
     - 5.2.1 demonstrate positive attitudes and behaviours
     - 5.2.2 be responsible
     - 5.2.3 be adaptable
     - 5.2.4 learn continuously
     - 5.2.5 work safely

5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment
6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2170: METAL REPAIR & FINISHING

Level: Intermediate

Prerequisite: MEC1170: Metal Forming & Finishing

Description: Students analyze and repair metal damage.

Parameters: Access to Gas Metal Arc Welding (GMAW) and Oxyacetylene Welding (OAW) welders, basic auto body hand/power tools and related resources.

Outcomes: The student will:

1. **demonstrate safe work practices when metal forming and finishing metal damage**
   - 1.1 demonstrate safe practices in relation to the:
     - 1.1.1 use of welding equipment
     - 1.1.2 use of solder and soldering equipment
     - 1.1.3 sheet metal straightening system
2. **identify different damage conditions and repair procedures for metal damage**
   - 2.1 identify and describe the type/extent of minor sheet metal damage
   - 2.2 list sequence of repair
   - 2.3 identify and describe major sheet metal impact damage conditions including:
     - 2.3.1 direct
     - 2.3.2 indirect
   - 2.4 list sequence of repair
3. **repair metal damage to a vehicle**
   - 3.1 demonstrate how to:
     - 3.1.1 perform metal straightening
     - 3.1.2 perform metal replacement work
     - 3.1.3 repair damaged aluminum panel
     - 3.1.4 repair a panel using body solder
     - 3.1.5 complete a large rust out repair
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems
   - 4.2 demonstrate personal management skills to:
     - 4.2.1 demonstrate positive attitudes and behaviours
     - 4.2.2 be responsible
     - 4.2.3 be adaptable
     - 4.2.4 learn continuously
     - 4.2.5 work safely
   - 4.3 demonstrate teamwork skills to:
     - 4.3.1 work with others
     - 4.3.2 participate in projects and tasks
5. **identify possible life roles related to the skills and content of this cluster**
   - 5.1 recognize and then analyze the opportunities and barriers in the immediate environment
   - 5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2180: TRIM REPLACEMENT

Level: Intermediate

Prerequisite: None

Description: Students demonstrate the removal and repair of trim parts, with an emphasis on removal and installation without damage.

Parameters: Access to specialized trim tools and related resources.

Supporting Course: MEC1190: Surface Preparation 1

Outcomes: The student will:

1. **demonstrate the safe use of tools and chemicals for trim replacement**
   - 1.1 identify hazards when working with trim
2. **investigate interior and exterior trim systems used to enhance appearances**
   - 2.1 identify the materials used for interior trim and the fastening system for each, and describe the correct method of removal
   - 2.2 describe the methods to remove and install interior trim
   - 2.3 describe precautions to be adhered to when removing and installing trim
   - 2.4 describe methods used to attach trim accessories, door locks, mirrors, etc.
   - 2.5 explain how to remove and replace specified trim
   - 2.6 identify fasteners specific to exterior trim, including clips and adhesives
   - 2.7 explain the inherent value of decals, vinyl and overlays
   - 2.8 describe procedures for the removal of decals, vinyl and overlays
   - 2.9 describe the function of weather stripping
   - 2.10 identify two or three different methods of weather stripping and explain the significance of the differences
   - 2.11 identify two or three procedures needed to remove accessories and implications for repair or replacement
3. **remove and install trim and weather stripping**
   - 3.1 demonstrate correct procedures and use of tools used in the removal of mouldings, emblems and accessories
   - 3.2 install selected exterior trim
   - 3.3 successfully remove and install a door seal, test seal and adjust hardware accordingly
4. **analyze and install enhancement trim e.g., locks, mirrors, lights**
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:
- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment

6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2190: SURFACE PREPARATION 2

Level: Intermediate

Prerequisite: MEC1190: Surface Preparation 1

Description: Students perform advanced surface preparations.

Parameters: Access to auto body hand/power tools and related resources.

Outcomes: The student will:

1. **demonstrate safe practices when performing advanced surface preparations**
   - 1.1 demonstrate safe practices in relation to chemicals
2. **explain materials and practices for performing advanced surface preparations**
   - 2.1 identify specific metal treatments including:
     - 2.1.1 aluminum
     - 2.1.2 plymetal
     - 2.1.3 galvanized
     - 2.1.4 other
   - 2.2 identify equipment, materials and accepted procedures in compounding surfaces
   - 2.3 match adhesion promoters to the type of plastic being finished
   - 2.4 use correct cleaning agent to match plastics and product used
   - 2.5 identify and describe custom masking methods
3. **carry out an advanced surface preparation**
   - 3.1 demonstrate how to:
     - 3.1.1 prepare bare metal
     - 3.1.2 clean and treat surface rust as conditions dictate
     - 3.1.3 compound surfaces
     - 3.1.4 prime plastic and metal components
     - 3.1.5 custom mask a small project
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems
   - 4.2 demonstrate personal management skills to:
     - 4.2.1 demonstrate positive attitudes and behaviours
     - 4.2.2 be responsible
     - 4.2.3 be adaptable
     - 4.2.4 learn continuously
     - 4.2.5 work safely
   - 4.3 demonstrate teamwork skills to:
     - 4.3.1 work with others
     - 4.3.2 participate in projects and tasks
5. **identify possible life roles related to the skills and content of this cluster**
   - 5.1 recognize and then analyze the opportunities and barriers in the immediate environment
   - 5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2200: REFINISHING 1

Level: Intermediate

Prerequisite: MEC2190: Surface Preparation 2

Description: Students demonstrate metal surface refinishing procedures.

Parameters: Access to spray equipment and related resources.

Outcomes: The student will:

1. **demonstrate safe practices and follow all warnings identified by product manufacturers, Workplace Hazardous Materials Information System (WHMIS), and Occupational Health and Safety**
   - 1.1 demonstrate knowledge of health hazards and environmental impacts of products used
   - 1.2 demonstrate use of personal protective equipment, as recommended by manufacturer
2. **identify and describe refinishing products and equipment**
   - 2.1 identify types of topcoats, solvents and additives
   - 2.2 identify and select colour and type of paint on a given vehicle
   - 2.3 demonstrate knowledge of proper procedure in paint preparation
   - 2.4 inspect pre-paint project and determine deficiencies
   - 2.5 identify basic spray gun types
   - 2.6 show how to troubleshoot a spray gun
   - 2.7 demonstrate knowledge of refinishing equipment accessories
   - 2.8 demonstrate knowledge of proper topcoat application techniques
   - 2.9 show how to troubleshoot basic application problems
3. **demonstrate proper refinishing application**
   - 3.1 prepare booth for spraying
   - 3.2 prepare and apply topcoat
   - 3.3 demonstrate knowledge of and perform the cleaning of spray guns
   - 3.4 perform final detailing by:
     - 3.4.1 removing masking tape
     - 3.4.2 checking and correcting surface defects
     - 3.4.3 completing the final cleaning and inspection
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems
   - 4.2 demonstrate personal management skills to:
     - 4.2.1 demonstrate positive attitudes and behaviours
     - 4.2.2 be responsible
     - 4.2.3 be adaptable
     - 4.2.4 learn continuously
     - 4.2.5 work safely

4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment
5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2210: TOUCH-UP & FINISHING

Level: Intermediate

Prerequisite: MEC2200: Refinishing 1

Description: Students determine and use the appropriate materials, tools and processes for minor surface repairs.

Parameters: Access to spray equipment and related resources.

Supporting Course: MEC1160: Structures & Materials

Outcomes: The student will:

1. **practice safe handling, use and disposal of hazardous touch-up and finishing products**
   - 1.1 demonstrate knowledge of the safety precautions required for:
     - 1.1.1 feather edging with dual action orbital sanders
     - 1.1.2 handling of primer products and putties
     - 1.1.3 spraying primers
2. **identify the techniques and products required to complete a minor surface repair**
   - 2.1 identify the imperfections in paint or freshly prepared surfaces; e.g., sand scratches, runs, dry spray, orange peel, bull's eye, sags, chips
   - 2.2 demonstrate the spot repair concepts, as required by industry, including colour matching concepts of two types of paint including:
     - 2.2.1 solids
     - 2.2.2 metallics
   - 2.3 describe the advantages of the base/clear system of paint in colour matching
3. **demonstrate the skills required to prepare and refinish a spot repair**
   - 3.1 perform a surface flaw repair of a painted panel, using sandpaper and compounds without repainting
   - 3.2 prepare a panel for a spot repair and follow appropriate instructions in the application of primer and paint
   - 3.3 show proper procedures in the application and sanding of putties
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems
   - 4.2 demonstrate personal management skills to:
     - 4.2.1 demonstrate positive attitudes and behaviours
     - 4.2.2 be responsible
     - 4.2.3 be adaptable
     - 4.2.4 learn continuously
     - 4.2.5 work safely
   - 4.3 demonstrate teamwork skills to:
     - 4.3.1 work with others
     - 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment

5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2220: INTERIOR REPAIRS

Level: Intermediate

Prerequisite: MEC1160: Structures & Materials

Description: Students search for and use the appropriate products and techniques to maintain vehicle interior surface materials.

Parameters: Access to interior materials, products, tools, equipment and related resources.

Outcomes: The student will:

1. **practice safe handling, use and disposal of hazardous cleaning and repair products**
   - 1.1 demonstrate knowledge of and follow safety rules and procedures for the products used for interior care
   - 1.2 identify hazards associated with the improper use of certain volatile chemicals
2. **analyze type of repair or restoration required, and identify the techniques/products necessary to repair and/or restore an interior surface**
   - 2.1 identify cleaners for the following materials:
     - 2.1.1 leather
     - 2.1.2 cloth
     - 2.1.3 vinyl
     - 2.1.4 rubber
     - 2.1.5 plastic
     - 2.1.6 polyurethane foam
   - 2.2 describe the correct procedures and products that can safely be used for cleaning and maintenance; e.g., volatile cleaners, neutral soaps, specialty products
   - 2.3 compile an identification of interior parts and clean the parts to "like-new" condition or "best as can be expected," depending on the condition; include glass in the cleaning
   - 2.4 identify and describe the nature of stains; e.g., soil, grease, oil, tar, blood, wax, chocolate, non-chocolate candy
   - 2.5 identify correct procedures for the removal of three of the above
   - 2.6 compile a chart showing the stain removal procedures, including special products, if required
3. **clean and/or repair an interior surface**
   - 3.1 replace the vinyl or cloth covering on a door rest
   - 3.2 complete a vinyl or plastic repair of a crack or hole in an interior part and refinish
   - 3.3 successfully remove and replace weather stripping in either a door glass area or door opening
   - 3.4 identify signs of poor sealing by weather stripping and adjust, if possible
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:
- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment

5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2910: MEC PROJECT B

Level: Intermediate

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Intermediate project courses must connect with a minimum of two CTS courses, one of which must be at the intermediate level and be in the same occupational area as the project course. The other CTS course(s) can be at any level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
   - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
   - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
   - 2.1 identify the project and/or performance by:
     - 2.1.1 preparing a plan
     - 2.1.2 clarifying the purposes
     - 2.1.3 defining the deliverables
     - 2.1.4 specifying time lines
     - 2.1.5 explaining terminology, tools and processes
     - 2.1.6 defining resources; e.g., materials, costs, staffing
   - 2.2 identify and comply with all related health and safety standards
   - 2.3 define assessment standards (indicators for success)
   - 2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
   - 3.1 complete the project and/or performance as outlined
   - 3.2 monitor the project and/or performance and make necessary adjustments
   - 3.3 present the project and/or performance, indicating the:
     - 3.3.1 outcomes attained
     - 3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment
5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2920: MEC PROJECT C

Level: Intermediate

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Intermediate project courses must connect with a minimum of two CTS courses, one of which must be at the intermediate level and be in the same occupational area as the project course. The other CTS course(s) can be at any level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
   - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
   - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
   - 2.1 identify the project and/or performance by:
     - 2.1.1 preparing a plan
     - 2.1.2 clarifying the purposes
     - 2.1.3 defining the deliverables
     - 2.1.4 specifying time lines
     - 2.1.5 explaining terminology, tools and processes
     - 2.1.6 defining resources; e.g., materials, costs, staffing
   - 2.2 identify and comply with all related health and safety standards
   - 2.3 define assessment standards (indicators for success)
   - 2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
   - 3.1 complete the project and/or performance as outlined
   - 3.2 monitor the project and/or performance and make necessary adjustments
   - 3.3 present the project and/or performance, indicating the:
     - 3.3.1 outcomes attained
     - 3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster

5.1 recognize and then analyze the opportunities and barriers in the immediate environment
5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC2950: MEC INTERMEDIATE PRACTICUM

Level: Intermediate

Prerequisite: None

Description: Students apply prior learning and demonstrate the attitudes, skills and knowledge required by an external organization to achieve a credential/credentials or an articulation.

Parameters: This practicum course, which may be delivered on- or off-campus, should be accessed only by students continuing to work toward attaining a recognized credential/credentials or an articulation offered by an external organization. This course must be connected to at least one CTS course from the same occupational area and cannot be used in conjunction with any advanced (3XXX) level course. A practicum course cannot be delivered as a stand-alone course, cannot be combined with a CTS project course and cannot be used in conjunction with the Registered Apprenticeship Program or the Green Certificate Program.

Outcomes: The student will:

1. perform assigned tasks and responsibilities, as required by the organization granting the credential(s) or articulation

- 1.1 identify regulations and regulatory bodies related to the credential(s) or articulation
- 1.2 describe personal roles and responsibilities, including:
  - 1.2.1 key responsibilities
  - 1.2.2 support functions/responsibilities/expectations
  - 1.2.3 code of ethics and/or conduct
- 1.3 describe personal work responsibilities and categorize them as:
  - 1.3.1 routine tasks; e.g., daily, weekly, monthly, yearly
  - 1.3.2 non-routine tasks; e.g., emergencies
  - 1.3.3 tasks requiring personal judgement
  - 1.3.4 tasks requiring approval of a supervisor
- 1.4 demonstrate basic employability skills and perform assigned tasks and responsibilities related to the credential(s) or articulation

2. analyze personal performance in relation to established standards

- 2.1 evaluate application of the attitudes, skills and knowledge developed in related CTS courses
- 2.2 evaluate standards of performance in terms of:
  - 2.2.1 quality of work
  - 2.2.2 quantity of work
- 2.3 evaluate adherence to workplace legislation related to health and safety
- 2.4 evaluate the performance requirements of an individual who is trained, experienced and employed in a related occupation in terms of:
  - 2.4.1 training and certification
  - 2.4.2 interpersonal skills
  - 2.4.3 technical skills
  - 2.4.4 ethics

3. demonstrate basic competencies

3.1 demonstrate fundamental skills to:

- 3.1.1 communicate
- 3.1.2 manage information
- 3.1.3 use numbers
- 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:

- 3.2.1 demonstrate positive attitudes and behaviours
- 3.2.2 be responsible
- 3.2.3 be adaptable
- 3.2.4 learn continuously
- 3.2.5 work safely

3.3 demonstrate teamwork skills to:

- 3.3.1 work with others
- 3.3.2 participate in projects and tasks

4. identify possible life roles related to the skills and content of this cluster

4.1 recognize and then analyze the opportunities and barriers in the immediate environment

4.2 identify potential resources to minimize barriers and maximize opportunities

COURSE MEC3010: BUYING & SELLING VEHICLES

Level: Advanced

Prerequisite: None

Description: Students develop the skills required to make an informed purchase or sale of a vehicle.

Parameters: Access to new and used vehicle reports and other related resources.

Outcomes: The student will:

1. **investigate and determine the type of vehicle that best meets a defined need**
   - 1.1 identify safety concerns when dealing with unfamiliar vehicles
   - 1.2 identify the factors that affect the choice of a vehicle including:
     - 1.2.1 intended use and length of service
     - 1.2.2 required performance and economy
     - 1.2.3 funds or financing available
     - 1.2.4 emotional appeal
     - 1.2.5 consumer reports
2. **evaluate and describe the condition of a vehicle**
   - 2.1 identify the parts of a vehicle that can be inspected by:
     - 2.1.1 visual means
     - 2.1.2 road testing
     - 2.1.3 instrument checks
   - 2.2 calculate the value of a vehicle by:
     - 2.2.1 having it appraised by more than one experienced individual
     - 2.2.2 comparing the appraisal to published prices
     - 2.2.3 calculating the value through depreciation
     - 2.2.4 comparing with the asking price of similar vehicles
3. **plan a strategy to sell or buy a vehicle**
   - 3.1 describe the advantages and disadvantages of purchasing a vehicle:
     - 3.1.1 privately
     - 3.1.2 by auction
     - 3.1.3 through dealers
     - 3.1.4 through lease agencies
     - 3.1.5 through rental agencies
     - 3.1.6 through government agencies
   - 3.2 select or recommend a seller based on:
     - 3.2.1 the seller's reputation
     - 3.2.2 ability to service
     - 3.2.3 willingness to back the product
     - 3.2.4 number of vehicles to choose from
   - 3.3 describe the advantages of selling a vehicle:
     - 3.3.1 on consignment
     - 3.3.2 privately
     - 3.3.3 on a trade

3.4 clean and restore the appearance of the vehicle to "next-to-new" standards
3.5 organize and prepare a record of the vehicle's service and maintenance record

4. recognize the legal rights and responsibilities of both the seller and purchaser

4.1 identify legal steps when buying and selling a vehicle
4.2 prepare an offer to purchase including:
- 4.2.1 condition and age of the vehicle
- 4.2.2 dealer cost
- 4.2.3 profit level
- 4.2.4 value of trade-in
- 4.2.5 cost of financing
- 4.2.6 ability to pay or make payment
- 4.2.7 possible liens

5. identify safety concerns and regulations when buying and selling vehicles that have been repaired after an accident

5.1 research and identify safety concerns when:
- 5.1.1 buying a vehicle
- 5.1.2 selling a vehicle that has had extensive repairs due to an accident

5.2 research and identify Internet sites providing vehicle information; e.g., vehicle information report from Alberta Transportation

6. demonstrate basic competencies

6.1 demonstrate fundamental skills to:
- 6.1.1 communicate
- 6.1.2 manage information
- 6.1.3 use numbers
- 6.1.4 think and solve problems

6.2 demonstrate personal management skills to:
- 6.2.1 demonstrate positive attitudes and behaviours
- 6.2.2 be responsible
- 6.2.3 be adaptable
- 6.2.4 learn continuously
- 6.2.5 work safely

6.3 demonstrate teamwork skills to:
- 6.3.1 work with others
- 6.3.2 participate in projects and tasks

7. create a transitional strategy to accommodate personal changes and build personal values

7.1 identify short-term and long-term goals
7.2 identify steps to achieve goals

COURSE MEC3020: VEHICLE VALUE APPRAISAL

Level: Advanced

Prerequisite: MEC2020: Vehicle Maintenance

Description: Students demonstrate the procedures used by the vehicle repair industry to estimate the cost of a repair and the market value of a vehicle.

Parameters: Access to new and used vehicle reports and other related resources.

Outcomes: The student will:

1. **demonstrate established safety and care procedures when inspecting vehicles**
   - 1.1 demonstrate knowledge of and follow predetermined shop guidelines when working on or around vehicles
2. **inspect a vehicle to determine its overall condition and repair requirements**
   - 2.1 investigate and report on the condition of a vehicle using a comprehensive method, including owner interview and inspection report completion
   - 2.2 examine and report on the system(s) that require repair to determine the extent of reconditioning required to return the system(s) to serviceability
   - 2.3 construct a basis for vehicle valuation by determining the vehicle characteristics that would contribute to market value; e.g., year, make, model, options, mileage, relative condition, emotional appeal, popularity
   - 2.4 complete an evaluation checklist
   - 2.5 list probable and possible parts required to effect a complete repair using original equipment, aftermarket and used parts
   - 2.6 use accepted industry labour guides to calculate the correct labour charges for the required parts replacements, considering all modifications or options to the subject vehicle
3. **apply standards used by the vehicle repair industry to appraise the condition and value of a vehicle**
   - 3.1 identify the wholesale value of a subject vehicle using the accepted wholesale reference guides
   - 3.2 calculate the market value of a subject vehicle by comparative pricing on three similar vehicles in the local marketplace
   - 3.3 identify the wholesale value of a subject vehicle using the accepted wholesale reference guides
   - 3.4 calculate the market value of a subject vehicle by comparative pricing on three similar vehicles in the local marketplace
4. **outline the best business practices to follow when situations of uncertainty or conflicting interests occur relative to an appraisal**
   - 4.1 describe business practices when resolving conflicts related to estimations and evaluations
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals
6.2 identify steps to achieve goals

COURSE MEC3030: ENGINE DIAGNOSIS

Level: Advanced

Prerequisite: MEC1040: Engine Fundamentals

Description: Students learn to diagnose the condition of an engine for worn or damaged parts and/or improper adjustments.

Parameters: Access to a vehicle engine, diagnostic test equipment and related resources.

Supporting Courses: MEC2030: Lubrication & Cooling
MEC2040: Fuel & Exhaust Systems
MEC2060: Ignition Systems
MEC2070: Emission Controls

Outcomes: The student will:

1. **demonstrate safe working practices while conducting an engine performance diagnosis**
   - 1.1 demonstrate safety while diagnosing engines
2. **diagnose the condition of an operating engine, using body senses; e.g., touch, sight, hearing**
   - 2.1 list possible engine problems based on information provided
   - 2.2 describe through listening, observing and touching a running and/or stopped engine whether abnormalities exist
   - 2.3 identify engine type and manufacturer's specifications
3. **assess engine conditions, using specialized test equipment and on-board diagnostic systems**
   - 3.1 demonstrate how to:
     - 3.1.1 analyze intake manifold vacuum
     - 3.1.2 check ignition timing and advance mechanisms
     - 3.1.3 check for proper idle speeds
     - 3.1.4 check engine oil pressure
     - 3.1.5 check cylinder compression readings
     - 3.1.6 check exhaust emissions
   - 3.2 identify any abnormalities on the vehicle using gauges and lights, including self-diagnostics
   - 3.3 use an engine analyzer and/or computerized tester to describe the condition of various engine systems as per capability of the test unit
4. **provide a report that describes the condition of an engine**
   - 4.1 compile all information and generate a report for the customer outlining defects found and recommended corrections
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals
6.2 identify steps to achieve goals

COURSE MEC3040: ENGINE TUNE-UP

Level: Advanced

Prerequisite: MEC3030: Engine Diagnosis

Description: Students diagnose, service and repair engine, fuel, ignition, charging and starting systems.

Parameters: Access to engine diagnostic equipment and supporting resources.

Supporting Courses:
MEC2030: Lubrication & Cooling
MEC2040: Fuel & Exhaust Systems
MEC2060: Ignition Systems
MEC2070: Emission Controls
MEC2090: Electrical Components
MEC3030: Engine Diagnosis

Outcomes: The student will:

1. **demonstrate safe work practices while performing an engine tune-up**
   1.1 demonstrate knowledge of and follow laboratory safety procedures
2. **determine the mechanical condition of an engine**
   1.2 demonstrate how to:
      2.1.1 perform a static and dynamic compression test to determine the mechanical condition of an engine
      2.1.2 do a leakdown test
   2.2 record and analyze results
3. **check and service a carburetor and a fuel injection system**
   3.1 identify whether a carburetor problem exists and document specific faults
   3.2 demonstrate how to:
      3.2.1 remove, clean and adjust a carburetor
      3.2.2 check and/or replace filters
      3.2.3 test fuel pump pressure and capacity
      3.2.4 clean fuel injectors
4. **use diagnostic equipment to check, interpret and service an ignition, and to check charging, starting, emission control and exhaust systems**
   4.1. demonstrate how to:
      4.1.1 use diagnostic equipment to diagnose an ignition system
      4.1.2 service spark plugs, wires, a distributor cap, a rotor, points, a pick-up coil, a spark advance
      4.1.3 check and adjust ignition timing
      4.1.4 operate starter and determine if problem exists; e.g., noises, drive engagement, speed
      4.1.5 check starter amperage draw and correct
      4.1.6 check starter circuit voltage drops and correct
      4.1.7 check battery condition and service
      4.1.8 do a visual check; i.e., wires, connections, belt condition/tension
      4.1.9 check alternator for noise and vibrations
      4.1.10 check alternator output and voltage regulation and correct

4.1.11 check charging circuit voltage drops and correct faults
4.1.12 diagnose computer-controlled systems and document faults
4.1.13 identify which emissions are being controlled
4.1.14 identify what emission control devices exist on a vehicle
4.1.15 identify to what standards these devices control emissions
4.1.16 check if vehicle meets standards and correct
4.1.17 road test vehicle to determine engine performance and driveability
4.1.18 compile a report outlining test results, work done and present condition of engine and related parts/systems

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:
- 5.1.1 communicate
- 5.1.2 manage information
- 5.1.3 use numbers
- 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:
- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals
6.2 identify steps to achieve goals

COURSE MEC3050: ENGINE REPLACEMENT

Level: Advanced

Prerequisite: MEC1040: Engine Fundamentals

Description: Students remove and install an engine in a chassis.

Parameters: Access to an engine lift, tools/equipment and supporting instructions and resources.

Supporting Courses: MEC3030: Engine Diagnosis
MEC3040: Engine Tune-up

Outcomes: The student will:

1. **use engine lifting equipment and related tools safely**
   - 1.1 demonstrate knowledge of types of lifting tools/equipment available for engines
   - 1.2 demonstrate knowledge of where to attach devices
   - 1.3 explain procedures to follow to remove and install an engine
   - 1.4 describe and follow precautions when working with a vehicle equipped with air conditioning
2. **identify steps involved to prepare a vehicle for engine removal**
   - 2.1 explain how to prepare a vehicle for engine removal
   - 2.2 identify all wiring, hoses, cables and pipes that require disconnecting
   - 2.3 identify units and special fasteners that will be removed
3. **apply mechanical skills to remove and replace engine accessories**
   - 3.1 identify the most appropriate method and remove and replace the following:
     - 3.1.1 wires
     - 3.1.2 cables
     - 3.1.3 hoses
     - 3.1.4 pipes
     - 3.1.5 accessories
4. **apply mechanical skills to remove and install an engine in a chassis**
   - 4.1 disconnect and service battery
   - 4.2 drain and dispose of lubricant and coolant
   - 4.3 remove appropriate wires, hoses, cables, pipes and units
   - 4.4 remove and/or install an engine
   - 4.5 dismantle/assemble an engine
   - 4.6 install lubricants/coolant
   - 4.7 service and store a battery
   - 4.8 drain/store or dispose of fluids
   - 4.9 identify the most appropriate method and remove and replace the following:
     - 4.9.1 cylinder head
     - 4.9.2 cylinder block
5. **perform post-engine installation start-up and adjustment procedures**
   - 5.1 adjust and service an engine
   - 5.2 start engine and check for proper performance
   - 5.3 perform post-engine installation vehicle clean-up for customer pick-up

6. demonstrate basic competencies

- 6.1 demonstrate fundamental skills to:
  - 6.1.1 communicate
  - 6.1.2 manage information
  - 6.1.3 use numbers
  - 6.1.4 think and solve problems
- 6.2 demonstrate personal management skills to:
  - 6.2.1 demonstrate positive attitudes and behaviours
  - 6.2.2 be responsible
  - 6.2.3 be adaptable
  - 6.2.4 learn continuously
  - 6.2.5 work safely
- 6.3 demonstrate teamwork skills to:
  - 6.3.1 work with others
  - 6.3.2 participate in projects and tasks

7. create a transitional strategy to accommodate personal changes and build personal values

- 7.1 identify short-term and long-term goals
- 7.2 identify steps to achieve goals

COURSE MEC3060: ENGINE RECONDITIONING – HEAD

Level: Advanced

Prerequisite: MEC1040: Engine Fundamentals

Description: Students determine the need for service and perform the required service on the cylinder head and related components of an engine.

Parameters: Access to cylinder head rebuilding equipment, measuring tools and related resources.

Supporting Courses: MEC3030: Engine Diagnosis
MEC3040: Engine Tune-up

Outcomes: The student will:

1. **demonstrate safe work procedures related to cylinder head work**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
2. **determine the condition of a cylinder head before and after disassembly**
   - 2.1 perform checks to determine the condition of a cylinder head and related parts
   - 2.2 describe blueprinting procedures for cylinder heads
   - 2.3 calculate costs of blueprinting
3. **recondition a cylinder head and its related components**
   - 3.1 clean a cylinder head and related parts
   - 3.2 inspect parts for serviceability
   - 3.3 machine parts
4. **reassemble and install a cylinder head**
   - 4.1 assemble a cylinder head and check valve spring and stem height
   - 4.2 service push rods, lifters, rocker arms, chains, gears, a camshaft, pulleys and belts
   - 4.3 install a cylinder head and make adjustments
   - 4.4 address unique concerns related to overhead camshaft engines
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems
   - 5.2 demonstrate personal management skills to:
     - 5.2.1 demonstrate positive attitudes and behaviours
     - 5.2.2 be responsible
     - 5.2.3 be adaptable
     - 5.2.4 learn continuously
     - 5.2.5 work safely
   - 5.3 demonstrate teamwork skills to:
     - 5.3.1 work with others
     - 5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals

6.2 identify steps to achieve goals

COURSE MEC3070: ENGINE RECONDITIONING – BLOCK

Level: Advanced

Prerequisite: MEC1040: Engine Fundamentals

Description: Students determine the need for service and perform service on a cylinder block assembly and related components of an engine.

Parameters: Access to engine measuring tools, cylinder block reconditioning tools/equipment and related resources.

Supporting Courses: MEC3030: Engine Diagnosis
MEC3040: Engine Tune-up
MEC3060: Engine Reconditioning – Head

Outcomes: The student will:

1. **demonstrate safe work procedures while reconditioning a cylinder block**
   - 1.1 demonstrate knowledge of and follow safety practices related to reconditioning cylinder blocks
2. **determine the condition of a cylinder block before and after disassembly**
   - 2.1 list possible engine problems based on information provided
   - 2.2 describe blueprinting procedures for cylinder blocks
   - 2.3 estimate costs
   - 2.4 clean all engine block components
   - 2.5 inspect the following components for serviceability:
     - 2.5.1 block alignment, warpage and cracks
     - 2.5.2 cylinder(s) size, taper, roundness and general condition
     - 2.5.3 crankshaft bends, cracks, journal size, tapes, roundness and general condition
     - 2.5.4 camshaft(s) bends, lobe/lift wear and journal size
     - 2.5.5 piston(s) size, taper, clearance and condition of pin(s) and grooves
     - 2.5.6 connecting rod(s) big/small-end size and straightness
     - 2.5.7 lifter(s) base wear, rate of leakdown
     - 2.5.8 bearing(s) size and wear
     - 2.5.9 chains, sprockets, pulleys and belts
     - 2.5.10 other
   - 2.6 identify what servicing is required
3. **recondition a cylinder block and its related components**
   - 3.1 machine/service components, as required
4. **reassemble a cylinder block assembly**
   - 4.1 assemble an engine block, observing proper tolerances
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals
6.2 identify steps to achieve goals

COURSE MEC3080: ALTERNATIVE ENERGY SYSTEMS

Level: Advanced

Prerequisite: MEC2050: Alternative Fuel Engines

Description: Students describe why vehicle manufacturers continue to build the crank-piston internal combustion gasoline engine. Students also identify and describe future engine designs.

Parameters: Access to support resources.

Supporting Course: MEC1040: Engine Fundamentals

Outcomes: The student will:

1. **research and describe the historical development of piston engine designs from Nicolaus Otto's engine to the present**
   - 1.1 prepare and present a report detailing the origin of the first working internal combustion engine, the major advances made in the design of internal combustion engines and the manufacturing process improvements that made those innovations possible over the history of engine design
   - 1.2 describe the development of and compare the relative efficacy of alternative contemporary design engines to the large-scale manufacture of motor vehicles
2. **describe the use of different fuels and engine designs in modern vehicles**
   - 2.1 identify the rationale for change in engine design considering environmental and fuel supply issues
   - 2.2 prepare and present a study of initiatives for using alternative fuels in engines and the factors affecting these advancements
   - 2.3 examine and report on the present initiatives to build electric-powered cars and batteries of sufficient capacity to power them
3. **identify and describe future developments in fuels and engine designs**
   - 3.1 identify which direction of alternative energy systems development promises to be most successful at this time
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems
   - 4.2 demonstrate personal management skills to:
     - 4.2.1 demonstrate positive attitudes and behaviours
     - 4.2.2 be responsible
     - 4.2.3 be adaptable
     - 4.2.4 learn continuously
     - 4.2.5 work safely
   - 4.3 demonstrate teamwork skills to:
     - 4.3.1 work with others
     - 4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals

5.2 identify steps to achieve goals

COURSE MEC3090: COMPUTER SYSTEMS

Level: Advanced

Prerequisite: MEC2070: Emission Controls

Description: Students provide an overview of the applications of computer management systems used in modern vehicles.

Parameters: Access to computer management system diagnostic equipment and related resources.

Supporting Course: MEC2090: Electrical Components

Outcomes: The student will:

1. **demonstrate established safety and care procedures related to computer management systems**
   - 1.1 demonstrate knowledge of and follow practices that promote safety for people and the environment
2. **identify the principles that apply to all computer management systems**
   - 2.1 identify the different computer control systems that are now available on vehicles
   - 2.2 explain the functions these computer control systems perform
   - 2.3 state the ways in which these computer control systems replaced mechanical systems
   - 2.4 demonstrate how selected computer control systems work compared to earlier mechanical systems
   - 2.5 identify the principles and functions of computer control systems
3. **locate the components of selected computer management systems and describe their function**
   - 3.1 locate and identify the parts of selected computer management systems
4. **demonstrate how computer management systems operate**
   - 4.1 describe the function of the parts of a selected computer management system
   - 4.2 forecast types of computer management systems that may be used on future vehicles
5. **perform diagnostic analyses of selected computer management systems and make required repairs to or replace malfunctioning parts**
   - 5.1 perform diagnostic analysis of selected computer management systems
   - 5.2 replace parts or make necessary repairs to correct malfunctioning computer management systems
6. **demonstrate basic competencies**
   - 6.1 demonstrate fundamental skills to:
     - 6.1.1 communicate
     - 6.1.2 manage information
     - 6.1.3 use numbers
     - 6.1.4 think and solve problems
   - 6.2 demonstrate personal management skills to:
     - 6.2.1 demonstrate positive attitudes and behaviours
     - 6.2.2 be responsible
     - 6.2.3 be adaptable
     - 6.2.4 learn continuously
     - 6.2.5 work safely

6.3 demonstrate teamwork skills to:
    6.3.1 work with others
    6.3.2 participate in projects and tasks

7. create a transitional strategy to accommodate personal changes and build personal values

7.1 identify short-term and long-term goals
7.2 identify steps to achieve goals

COURSE MEC3100: SAFETY SYSTEMS

Level: Advanced

Prerequisite: MEC2100: Power Assist Accessories

Description: Students describe how safety systems can be tested, diagnosed, replaced or repaired.

Parameters: Access to related resources and vehicles with safety systems.

Note: Customer work must be checked by a certified technician.

Supporting Course: MEC2090: Electrical Components

Outcomes: The student will:

1. **demonstrate established safety and care procedures while working with safety systems**
   - 1.1 demonstrate knowledge of and follow established safety rules when working on safety systems
   - 1.2 demonstrate the use of safety procedures and precautions necessary to avoid damage to vehicle safety systems
2. **list and compare safety systems that protect vehicle occupants**
   - 2.1 describe vehicle safety systems and indicate the types of systems and dates when various systems were introduced
   - 2.2 explain the effect various safety systems have had in reducing fatalities
   - 2.3 identify and describe which safety systems are most effective in terms of saving human lives, cost of manufacture and ease of use
3. **diagnose and service vehicle safety systems**
   - 3.1 identify safety systems in selected vehicles
   - 3.2 list the parts of these safety systems
   - 3.3 describe the function of these safety systems
   - 3.4 diagnose the condition and any problems found on safety systems
   - 3.5 replace parts or make repairs to malfunctioning parts of safety systems
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems
   - 4.2 demonstrate personal management skills to:
     - 4.2.1 demonstrate positive attitudes and behaviours
     - 4.2.2 be responsible
     - 4.2.3 be adaptable
     - 4.2.4 learn continuously
     - 4.2.5 work safely
   - 4.3 demonstrate teamwork skills to:
     - 4.3.1 work with others
     - 4.3.2 participate in projects and tasks
5. **create a transitional strategy to accommodate personal changes and build personal values**
   - 5.1 identify short-term and long-term goals
   - 5.2 identify steps to achieve goals

COURSE MEC3110: CLIMATE CONTROL

Level: Advanced

Prerequisite: MEC2030: Lubrication & Cooling

Description: Students expand their knowledge of the purpose, operation and servicing of standard heating and air conditioning systems.

Parameters: Access to air conditioning test equipment and related resources.

Note: Work must be supervised and checked by a certified technician when student is working with refrigerants.

Outcomes: The student will:

1. **demonstrate established safety and care procedures when working with climate control systems**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 generate a list of safety concerns when working with refrigerants
   - 1.3 outline the legal restrictions about the disposal and recycling of R12 refrigerants
   - 1.4 identify the safety and environmental concerns with R12 and R12 replacements
2. **identify the purpose and describe the functions of heater and air conditioning system components**
   - 2.1 describe the operation of a heater; e.g., heat exchange, the operation of controls for fan speed, air flow controls
   - 2.2 identify components of an air conditioning system
   - 2.3 describe refrigeration principles
   - 2.4 describe air conditioning system operation
3. **perform inspection, diagnosis, service and repair procedures on heater and air conditioning systems**
   - 3.1 identify the causes and repair procedures for standard heater operation malfunctions; e.g., blocked or leaking heater core, temperature cable adjustment, fan motor noise, vibration, speed abnormalities
   - 3.2 show how to conduct a visual and tactile check of the operation of the refrigerant system and assess the service needs
   - 3.3 identify the cause of malfunction in a climate control system and repair, as required, after consulting with the vehicle owner/teacher
   - 3.4 pressure test the air conditioning refrigerant system and confirm the normalcy of system operation by comparing data with the service manual
   - 3.5 on the air conditioning system, perform a leak test, evacuate system, recharge, then perform leak test again
4. **identify global concerns about the release of refrigerants into the atmosphere as well as the alternatives to standard refrigerants, and identify the required recycling procedures**
   - 4.1 research the effect of refrigerants on the ecosystem
   - 4.2 research alternate refrigerants

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:

- 5.1.1 communicate
- 5.1.2 manage information
- 5.1.3 use numbers
- 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:

- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:

- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals

6.2 identify steps to achieve goals

COURSE MEC3120: POWER ASSISTING

Level: Advanced

Prerequisite: MEC2100: Power Assist Accessories

Description: Students further develop their knowledge of the purpose, operation, service and repair of pneumatic, hydraulic and electric power assist devices.

Parameters: Access to vacuum/pressure gauges, electrical test equipment and related resources.

Supporting Course: MEC2120: Hydraulic Accessories

Outcomes: The student will:

1. **demonstrate established safety and care procedures when working with power assists**
   - 1.1 demonstrate knowledge of and follow established laboratory procedures
2. **identify applications of power assist components to various vehicle systems and determine the rationale for each application**
   - 2.1 describe situations in vehicle system design where power assist mechanisms are used
   - 2.2 define the advantages of power assist over manual control and identify the type of power assist most appropriate for use in a particular situation such as steering or braking
3. **perform service and repair procedures to pneumatic, hydraulic and electric power assist devices according to manufacturer's recommendations**
   - 3.1 complete an inspection of a hydraulic power assist device using manufacturer's prescribed diagnostic procedures
   - 3.2 estimate the repair costs for a defective or broken hydraulic assist and confer with the teacher or vehicle owner regarding the repair requirements
   - 3.3 complete an inspection of a pneumatic assist device or system using prescribed diagnostic procedures
   - 3.4 prepare an estimate of the repair requirements of a pneumatic assist and confer with the teacher or vehicle owner regarding the repair needs
   - 3.5 complete an inspection of an electric assist device using a prescribed diagnostic procedure
   - 3.6 prepare an estimate of the repair requirements for an electric assist device and confer with the teacher or vehicle owner regarding the required repairs
   - 3.7 complete a repair procedure on an electric assist device or system
   - 3.8 complete a repair procedure on a hydraulic assist unit
   - 3.9 complete a repair procedure on a pneumatic assist unit or system
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

MODULE MEC3130: AUTOMATIC TRANSMISSIONS

Level: Advanced

Prerequisite: MEC1110: Pneumatics & Hydraulics

Description: Students develop knowledge of automatic transmissions and transaxles and skills in diagnosing and executing minor automatic transmission and transaxle repair requirements.

Parameters: Access to automatic transmission diagnostic tools and support resources.

Note: Customer work must be supervised and checked by a certified technician.

Supporting Course: MEC2140: Transmissions/Transaxles

Outcomes: The student will:

1. **demonstrate established safety and care procedures when working with automatic transmissions and transaxles**
   - 1.1 demonstrate knowledge of and follow established laboratory procedures
2. **identify the parts of a torque converter and automatic transmission or transaxle, and determine the path of power and the shifting control operation in each gear setting**
   - 2.1 describe the operation of a torque converter
   - 2.2 compare the internal structure of a lock-up converter and nonlock-up converter
   - 2.3 identify the parts of a transmission assembly by naming pieces on a diagram or parts of a disassembled unit
   - 2.4 using a hydraulic flow diagram, explain the unit engaged and shift process for each gear position
   - 2.5 interpret shifting characteristics resulting from differentiated inputs; e.g., high road speed, pulling heavy loads, throttle valve position
3. **inspect, diagnose, service and complete a minor repair to an automatic transmission and transaxle assembly**
   - 3.1 use the service manual and a road test to determine probable causes of noted conditions
   - 3.2 complete diagnostic procedures developed from service inquiry, which may include linkage adjustments, pressure testing and further road testing as well as partial disassembly of the transmission
   - 3.3 perform a stall test according to manufacturer's specifications
   - 3.4 list parts for required repairs
   - 3.5 inspect transmission/transaxle oil level and develop an assessment of its odour and colour
   - 3.6 change transmission fluid and filter as described in the appropriate service manual
   - 3.7 check unit for oil leakage and determine a cause for loss of oil
   - 3.8 repair a fluid leak
   - 3.9 evaluate the condition and adjustment of linkage
   - 3.10 locate and correct a transmission linkage or band adjustment, where required
   - 3.11 remove, clean and reinstall a transmission valve body assembly
4. **perform a service and repair procedure on an automatic transmission**
   - 4.1 remove, repair or replace an automatic transmission assembly

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:

- 5.1.1 communicate
- 5.1.2 manage information
- 5.1.3 use numbers
- 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:

- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:

- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals

6.2 identify steps to achieve goals

COURSE MEC3140: DRIVE TRAIN REPAIR

Level: Advanced

Prerequisite: MEC2130: Drive Line

Description: Students perform overhauls on clutch, transmission and differential assemblies.

Parameters: Access to specialized drive line tools, drive line units and related resources.

Supporting Course: MEC2140: Transmissions/Transaxles

Outcomes: The student will:

1. **demonstrate established safe work practices and follow established laboratory procedures**
   - 1.1 demonstrate knowledge of and follow established laboratory procedures
2. **replace a clutch assembly**
   - 2.1 remove and replace a clutch assembly
   - 2.2 identify the serviceability of each part
   - 2.3 adjust linkage to specified clearance
3. **explain the operation, removal, overhaul and replacement of a manual transmission/transaxle**
   - 3.1 explain the operation and power flow in various transmissions and transaxles
   - 3.2 remove and replace specified transmission and overhaul to manufacturer's specifications
4. **describe, measure and adjust a differential assembly**
   - 4.1 describe types of differential assemblies and explain the operation of the following:
     - 4.1.1 full-floating
     - 4.1.2 semi-floating
     - 4.1.3 hunting
     - 4.1.4 non-hunting
   - 4.2 describe the operation of a limited slip differential assembly
   - 4.3 measure and adjust a differential assembly
5. **describe and overhaul a drive axle assembly**
   - 5.1 describe drive axle operation and components of four-wheel, front-wheel and rear-wheel drive vehicles
   - 5.2 overhaul constant velocity joints
6. **demonstrate basic competencies**
   - 6.1 demonstrate fundamental skills to:
     - 6.1.1 communicate
     - 6.1.2 manage information
     - 6.1.3 use numbers
     - 6.1.4 think and solve problems
   - 6.2 demonstrate personal management skills to:
     - 6.2.1 demonstrate positive attitudes and behaviours
     - 6.2.2 be responsible
     - 6.2.3 be adaptable
     - 6.2.4 learn continuously
     - 6.2.5 work safely

6.3 demonstrate teamwork skills to:
    6.3.1 work with others
    6.3.2 participate in projects and tasks

7. create a transitional strategy to accommodate personal changes and build personal values

7.1 identify short-term and long-term goals
7.2 identify steps to achieve goals

COURSE MEC3150: WHEEL ALIGNMENT

Level: Advanced

Prerequisite: MEC2150: Suspension Systems

Description: Students develop the knowledge, skills and attitudes necessary for repairing and aligning various vehicle steering systems.

Parameters: Access to wheel alignment equipment and supporting resources.

Note: Customer work must be supervised and checked by a certified technician.

Supporting Course: MEC2160: Steering Systems

Outcomes: The student will:

1. **follow established safe work procedures**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
2. **investigate and determine the condition of various components that affect wheel alignment and tracking**
   - 2.1 solve common steering and suspension problems including:
     - 2.1.1 loose steering
     - 2.1.2 hard steering
     - 2.1.3 vehicle wander
     - 2.1.4 pulling to one side
     - 2.1.5 wheel shimmy
     - 2.1.6 wheel tramp
     - 2.1.7 improper tire wear
3. **identify measurements and angles used to check and adjust suspension and steering systems**
   - 3.1 define and explain camber, caster, toe, steering axis inclination, toe-out on turns and tracking
4. **use specialized alignment equipment to check and adjust alignment angles on various suspension types to manufacturer's specifications**
   - 4.1 demonstrate how to:
     - 4.1.1 check and correct tire pressures and determine reason for abnormal tire wear
     - 4.1.2 check and adjust wheel bearings
     - 4.1.3 check and adjust wheel/tire runout
     - 4.1.4 check and correct tire balance
     - 4.1.5 check and correct steering linkage problems
     - 4.1.6 check and adjust steering gear
     - 4.1.7 check and correct shock absorber problems
     - 4.1.8 check and correct riding height
     - 4.1.9 check vehicle tracking
   - 4.2 check alignment angles for a given vehicle using the appropriate alignment equipment
   - 4.3 adjust alignment angles to manufacturer's specifications on at least two different suspension types

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:

- 5.1.1 communicate
- 5.1.2 manage information
- 5.1.3 use numbers
- 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:

- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:

- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals

6.2 identify steps to achieve goals

COURSE MEC3160: BODY REPAIR ESTIMATION

Level: Advanced

Prerequisite: MEC1160: Structures & Materials

Description: Students apply knowledge in estimating, including paying close attention to detail in determining the cost of a repair.

Parameters: Access to supporting resources.

Outcomes: The student will:

1. **demonstrate established laboratory procedures and safe work practices**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 identify mechanical and electrical components often damaged in collision, and state appropriate safety precautions in dealing with gasoline, oil, air conditioning and battery acid hazards
2. **identify and describe types of body damage**
   - 2.1 list and describe the terms used in the appraisal industry
   - 2.2 describe vehicle construction systems, e.g., unibody, framed, and safety requirements
   - 2.3 examine the effects of collision on vehicle structure, parts and passenger safety equipment
   - 2.4 demonstrate the effects of forces on metal and show how manufacturing techniques are used to absorb collision energy
   - 2.5 define the terms “primary damage,” “secondary damage” and “hidden damage”
3. **outline skills needed to successfully estimate collision damage**
   - 3.1 identify related damaged parts
   - 3.2 investigate and describe collision damage to determine direction of damage, identify parts damaged, including hidden damage, and list signs of hidden damage
   - 3.3 conduct tests to determine mechanical and/or electrical functions in order to properly estimate cost of collision damage
4. **complete an estimate by determining what parts/components are to be replaced or repaired and their subsequent costs**
   - 4.1 estimate cost including parts, labour and miscellaneous
   - 4.2 calculate the cost of original equipment, aftermarket and used parts that could be used in a repair
   - 4.3 complete a replacement parts list for a given collision, including cost, extended cost and contracted costs
   - 4.4 list examples of hidden and other costs that must be included in an estimate of collision damage
   - 4.5 describe the responsibility of the shop to the customer, the insurer and legal parties in doing an estimate; e.g., safety of vehicle
   - 4.6 define write-off and explain when a vehicle is considered a write-off and non-repairable
   - 4.7 explain the advantages of having knowledge of vehicle structure and repair procedures when completing an estimate for repair
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals
6.2 identify steps to achieve goals

COURSE MEC3170: DAMAGE ANALYSIS

Level: Advanced

Prerequisite: MEC2170: Metal Repair & Finishing

Description: Students identify and examine physical damage caused by collisions and learn cost estimating procedures.

Parameters: Access to a damaged vehicle, measuring gauges and related resources.

Supporting Courses: MEC2150: Suspension Systems
MEC2160: Steering Systems

Outcomes: The student will:

1. **demonstrate established safe work procedures**
   - 1.1 demonstrate knowledge of and follow established laboratory procedures
2. **identify types and signs of collision damage**
   - 2.1 describe manufacturer's methods used in vehicle construction and define the terms used to identify vehicle body parts
   - 2.2 describe methods used in vehicle construction to control damage through energy transfer and differences in structural strength
   - 2.3 identify the specific occupant safety features built into the vehicle as required by law or provided as a vehicle option
   - 2.4 demonstrate basic principles of estimating damage repair and apply to a specific situation
   - 2.5 estimate the repair or replacement of safety equipment damaged in a collision
   - 2.6 identify the basic frame structures used in auto construction, and describe the measurement charts used to determine misalignment
3. **examine and use measurements to determine the extent of vehicle damage**
   - 3.1 calculate frame alignment measurements to determine the extent of misalignment and explain the results of the measurements
   - 3.2 use frame gauges and charts
   - 3.3 analyze measurements and determine repair procedure
4. **prepare a repair strategy for a given vehicle**
   - 4.1 explain the value of using used, aftermarket or original equipment parts in any given repair
   - 4.2 complete a damage analysis for a given vehicle
   - 4.3 prepare a strategy plan showing correct repair sequence
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals
6.2 identify steps to achieve goals

COURSE MEC3180: DAMAGE REPAIR 1

Level: Advanced

Prerequisite: MEC2170: Metal Repair & Finishing

Description: Students examine the methods used to complete a repair involving removing, replacing and aligning body parts.

Parameters: Access to specialized auto body tools, hand tools and related resources.

Note: The student must have access to instruction from an individual with journeyperson qualifications if students are involved in customer work.

Supporting Course: MEC3170: Damage Analysis

Outcomes: The student will:

1. **demonstrate established safety procedures**
   - 1.1 demonstrate knowledge of and follow established laboratory procedures
   - 1.2 demonstrate approved safety procedures in the use of jacks, jack stands, impact wrenches, torches, plasma arc and abrasive cutters to remove or replace parts
   - 1.3 demonstrate knowledge, skills and attitudes in the safe use of hand tools
2. **follow an approved sequence of repairs involving removing and replacing damaged external parts**
   - 2.1 examine damage to external parts and identify appropriate repair sequence
   - 2.2 complete a list of required parts and show cost effectiveness of using aftermarket or used parts
   - 2.3 list methods used in the manufacture of vehicles to align adjacent parts, including shims, slotted holes and bending
   - 2.4 examine the bumper shock system and explain the effects of collision to bumper shocks and their alignment
   - 2.5 describe the importance of correct alignment of body parts and the effects of misalignment, both aesthetically and physically
3. **align parts used to repair and prepare components for painting or priming**
   - 3.1 demonstrate knowledge and skill in the preparation of existing flanges, edges and mounting points used for the replacement of new parts
   - 3.2 safely remove and replace a door, hood and/or trunk lid
   - 3.3 replace and align a fender
4. **remove, repair or replace trim parts, as required**
   - 4.1 explain the function of trim
   - 4.2 identify methods of trim fastening
   - 4.3 successfully remove trim and damaged parts, showing knowledge of tools and care for property
   - 4.4 install new or original trim and recognize the value of using original equipment trim parts
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals
6.2 identify steps to achieve goals

COURSE MEC3190: DAMAGE REPAIR 2

Level: Advanced

Prerequisite: MEC3180: Damage Repair 1

Description: Students examine methods used to complete a collision repair involving unibody parts replacement and frame correction.

Parameters: Access to hydraulic push/pull equipment, Gas Metal Arc Welding (GMAW) and cutting equipment, basic auto body tools and related resources.

Note: The students must have access to instruction from an individual with journeyperson qualifications if they are involved in customer work.

Supporting Courses: MEC2150: Suspension Systems
MEC2160: Steering Systems
MEC2170: Metal Repair & Finishing
MEC2190: Surface Preparation 2

Outcomes: The student will:

1. **demonstrate established safe work procedures**
   - 1.1 demonstrate knowledge of and follow laboratory safety procedures
   - 1.2 demonstrate safety procedures required in the use of hydraulic jacks, GMAW welding and oxyacetylene and/or plasma arc cutting equipment
   - 1.3 list the safety implications of collision damage causing suspension misalignment, including legal implications
2. **describe construction features and materials used in vehicle bodies and methods of repair**
   - 2.1 identify and describe three kinds of frame structures, giving the advantages and applications of each
   - 2.2 define the terms high strength steel (HSS) and high strength low alloy (HSLA) steel, and explain the need for these metals in unibody construction
   - 2.3 describe the bench system used by professional auto repair shops in unibody collision repair
3. **identify misalignment of frame and suspension parts and components**
   - 3.1 describe and use measurements and measurement charts to determine the degree of misalignment
   - 3.2 define the terms “twist,” “sag,” “sway” and “diamond”
   - 3.3 describe measurements that will indicate each of the above conditions
4. **use a bench frame-straightening system and related measurements to straighten/align a component**
   - 4.1 use a bench, or equivalent, frame-straightening system to correct alignment
   - 4.2 align and fabricate damaged parts
5. **correct frame/body alignment involving replacement of unibody panels and use of hydraulic jacks and welders**
   - 5.1 describe the correct procedure used to repair a unibody frame that shows misalignment
   - 5.2 demonstrate how to use hydraulic jacking systems in the repair of collision damage

6. explain the importance of proper frame and suspension alignment, including legal implications

6.1 identify three kinds of suspension systems used by automakers

6.2 define the terms toe-in, camber and castor, and explain how each affects car tracking and driveability

7. demonstrate basic competencies

7.1 demonstrate fundamental skills to:

- 7.1.1 communicate
- 7.1.2 manage information
- 7.1.3 use numbers
- 7.1.4 think and solve problems

7.2 demonstrate personal management skills to:

- 7.2.1 demonstrate positive attitudes and behaviours
- 7.2.2 be responsible
- 7.2.3 be adaptable
- 7.2.4 learn continuously
- 7.2.5 work safely

7.3 demonstrate teamwork skills to:

- 7.3.1 work with others
- 7.3.2 participate in projects and tasks

8. create a transitional strategy to accommodate personal changes and build personal values

8.1 identify short-term and long-term goals

8.2 identify steps to achieve goals

COURSE MEC3200: REFINISHING 2

Level: Advanced

Prerequisite: MEC2200: Refinishing 1

Description: Students demonstrate finishing skills and techniques related to the preparation and application of metallic paints.

Parameters: Access to spray equipment and related resources.

Outcomes: The student will:

1. **demonstrate safe work practices and follow all warnings identified by product manufacturers, Workplace Hazardous Materials Information System (WHMIS), and Occupational Health and Safety**
   - 1.1 demonstrate knowledge of health hazards and environmental impacts of products used
   - 1.2 demonstrate use of personal protective equipment as recommended by manufacturer
2. **describe topcoats, solvents and additives used in surface finishes**
   - 2.1 identify three types of topcoats and describe characteristics showing similarities and differences
   - 2.2 demonstrate and explain correct procedures in preparing topcoats for application including correct selection of solvents and additives
3. **apply metallic, tutone, base/clear coat and acrylic enamel finishes**
   - 3.1 identify and select colour and type of paint for given vehicle identification plates and code books
   - 3.2 identify differences in spray gun types and uses
   - 3.3 describe refinishing equipment accessories
   - 3.4 select, mix and apply two or more of the following finishes:
     - 3.4.1 acrylic enamel
     - 3.4.2 metallic
     - 3.4.3 tutone
     - 3.4.4 base/clear coat
   - 3.5 complete a vehicle recoat
4. **apply problem-solving techniques to paint and equipment problems**
   - 4.1 solve paint and equipment problems observed during application
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems
   - 5.2 demonstrate personal management skills to:
     - 5.2.1 demonstrate positive attitudes and behaviours
     - 5.2.2 be responsible
     - 5.2.3 be adaptable
     - 5.2.4 learn continuously
     - 5.2.5 work safely

5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

6.1 identify short-term and long-term goals
6.2 identify steps to achieve goals

COURSE MEC3210: PLASTIC & FIBREGLASS

Level: Advanced

Prerequisite: MEC1160: Structures & Materials

Description: Students determine the types of plastic and fibreglass materials required for repairs and perform appropriate repair procedures.

Parameters: Access to plastic welding equipment and related materials and resources.

Outcomes: The student will:

1. **identify hazards and safety precautions to be observed when working with plastics**
   - 1.1 demonstrate knowledge of and follow accepted safety practices when working with hot liquids, plastic solvents, resins and equipment
2. **describe types of plastics, welding equipment and bonding processes used to repair plastic parts**
   - 2.1 identify and state characteristics of plastics used in vehicle manufacture
   - 2.2 identify plastics that can be repaired by welding and bonding
   - 2.3 explain the types of plastic welding equipment available and when this repair process should be used
   - 2.4 identify welding rods
   - 2.5 explain which bonding agents are available and their application
   - 2.6 identify types of plastic and decide whether to weld or bond
   - 2.7 state why a particular process was chosen
3. **apply plastic welding and/or bonding techniques to repair a plastic component**
   - 3.1 identify correct layout
   - 3.2 prepare "witness lines" for repeat layout
   - 3.3 prepare/clean plastic material as per instructions for process used
   - 3.4 create a solid lay-up
   - 3.5 weld/bond materials
   - 3.6 prepare damaged area
   - 3.7 prepare material
   - 3.8 apply material
4. **identify types of fibreglass materials and repair procedures**
   - 4.1 identify three kinds of fibreglass material
   - 4.2 identify and describe related resin/hardeners and repair procedures
5. **perform a fibreglass repair on a component**
   - 5.1 using safe handling techniques and prepare damaged area
   - 5.2 demonstrate correct application of material
   - 5.3 demonstrate approved finishing steps
6. **demonstrate basic competencies**
   - 6.1 demonstrate fundamental skills to:
     - 6.1.1 communicate
     - 6.1.2 manage information
     - 6.1.3 use numbers
     - 6.1.4 think and solve problems

6.2 demonstrate personal management skills to:
- 6.2.1 demonstrate positive attitudes and behaviours
- 6.2.2 be responsible
- 6.2.3 be adaptable
- 6.2.4 learn continuously
- 6.2.5 work safely

6.3 demonstrate teamwork skills to:
- 6.3.1 work with others
- 6.3.2 participate in projects and tasks

7. create a transitional strategy to accommodate personal changes and build personal values

7.1 identify short-term and long-term goals

7.2 identify steps to achieve goals

COURSE MEC3220: GLASS REPLACEMENT

Level: Advanced

Prerequisite: MEC2180: Trim Replacement

Description: Students demonstrate knowledge, skills and practice related to vehicle glass installation and adjustment.

Parameters: Access to glass removal tools, related materials/resources and glazed vehicles.

Outcomes: The student will:

1. **handle glass and related materials safely**
   - 1.1 identify safety concerns when working with glass
   - 1.2 show knowledge of safety procedures needed in glass removal
   - 1.3 identify installation product safety concerns in the glass industry
2. **identify glass types and glass retaining systems**
   - 2.1 identify types of glass and retaining systems used in the auto industry
   - 2.2 outline the removal procedures required for two different systems
   - 2.3 show knowledge of trim parts used around glass
3. **demonstrate knowledge of tools and procedures used by glass technicians**
   - 3.1 identify moulding retainers, glass seal products and procedures for installation
   - 3.2 identify door glass adjustment methods
4. **complete glass removal installations and adjustments**
   - 4.1 remove front or rear glass following safety guidelines
   - 4.2 install several glass systems, including door glass and side lights
   - 4.3 adjust door glass on several different systems
5. **demonstrate basic competencies**
   - 5.1 demonstrate fundamental skills to:
     - 5.1.1 communicate
     - 5.1.2 manage information
     - 5.1.3 use numbers
     - 5.1.4 think and solve problems
   - 5.2 demonstrate personal management skills to:
     - 5.2.1 demonstrate positive attitudes and behaviours
     - 5.2.2 be responsible
     - 5.2.3 be adaptable
     - 5.2.4 learn continuously
     - 5.2.5 work safely
   - 5.3 demonstrate teamwork skills to:
     - 5.3.1 work with others
     - 5.3.2 participate in projects and tasks
6. **create a transitional strategy to accommodate personal changes and build personal values**
   - 6.1 identify short-term and long-term goals
   - 6.2 identify steps to achieve goals

COURSE MEC3230: REFINISHING 3

Level: Advanced

Prerequisite: MEC3200: Refinishing 2

Description: Students demonstrate knowledge and skills of advanced finishing techniques, including custom painting, mixing, tinting, colour and texture matching.

Parameters: Access to spray equipment, surface repair equipment and related resources.

Outcomes: The student will:

1. **demonstrate safe work practices, and follow all product warnings and labels identified by the product manufacturers, Workplace Hazardous Materials Information System (WHMIS), and Occupational Health and Safety**
   - 1.1 demonstrate knowledge of health hazards and environmental impacts of products used
   - 1.2 demonstrate knowledge of special procedures in the preparation of plastic and vinyl parts
2. **investigate and describe advanced products, techniques and equipment used to achieve an acceptable original equipment manufacturer finish**
   - 2.1 explain alternative spray equipment
   - 2.2 describe types and uses of spray booths
   - 2.3 explain compressors and drying systems
   - 2.4 identify styles and techniques of custom painting
   - 2.5 explain mixing and tinting systems
   - 2.6 analyze colour/texture and identify the following:
     - 2.6.1 lightness/darkness
     - 2.6.2 cast
     - 2.6.3 brightness
   - 2.7 describe how colours are matched
   - 2.8 explain how to create textured finishes
   - 2.9 describe various paint mixing/tinting procedures
3. **apply an advanced level finish**
   - 3.1 demonstrate advanced topcoat application techniques
   - 3.2 identify styles and techniques of custom painting
   - 3.3 apply a custom paint job
   - 3.4 perform advanced troubleshooting of application/equipment problems
   - 3.5 demonstrate proper selection and application of colour coats for plastic and vinyl
4. **demonstrate basic competencies**
   - 4.1 demonstrate fundamental skills to:
     - 4.1.1 communicate
     - 4.1.2 manage information
     - 4.1.3 use numbers
     - 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE MEC3910: MEC PROJECT D

Level: Advanced

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Advanced project courses must connect with a minimum of two CTS courses, one of which must be at the advanced level and be in the same occupational area as the project course. The other CTS course(s) must be at least at the intermediate level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
   - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
   - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
   - 2.1 identify the project and/or performance by:
     - 2.1.1 preparing a plan
     - 2.1.2 clarifying the purposes
     - 2.1.3 defining the deliverables
     - 2.1.4 specifying time lines
     - 2.1.5 explaining terminology, tools and processes
     - 2.1.6 defining resources; e.g., materials, costs, staffing
   - 2.2 identify and comply with all related health and safety standards
   - 2.3 define assessment standards (indicators for success)
   - 2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
   - 3.1 complete the project and/or performance as outlined
   - 3.2 monitor the project and/or performance and make necessary adjustments
   - 3.3 present the project and/or performance, indicating the:
     - 3.3.1 outcomes attained
     - 3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE MEC3920: MEC PROJECT E

Level: Advanced

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Advanced project courses must connect with a minimum of two CTS courses, one of which must be at the advanced level and be in the same occupational area as the project course. The other CTS course(s) must be at least at the intermediate level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
   - 1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
   - 1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
   - 2.1 identify the project and/or performance by:
     - 2.1.1 preparing a plan
     - 2.1.2 clarifying the purposes
     - 2.1.3 defining the deliverables
     - 2.1.4 specifying time lines
     - 2.1.5 explaining terminology, tools and processes
     - 2.1.6 defining resources; e.g., materials, costs, staffing
   - 2.2 identify and comply with all related health and safety standards
   - 2.3 define assessment standards (indicators for success)
   - 2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
   - 3.1 complete the project and/or performance as outlined
   - 3.2 monitor the project and/or performance and make necessary adjustments
   - 3.3 present the project and/or performance, indicating the:
     - 3.3.1 outcomes attained
     - 3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies

4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values

5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE MEC3950: MEC ADVANCED PRACTICUM

Level: Advanced

Prerequisite: None

Description: Students apply prior learning and demonstrate the attitudes, skills and knowledge required by an external organization to achieve a credential/credentials or an articulation.

Parameters: This practicum course, which may be delivered on- or off-campus, should be accessed only by students continuing to work toward attaining a recognized credential/credentials or an articulation offered by an external organization. This course must be connected to at least one CTS course from the same occupational area and cannot be used in conjunction with any introductory (1XXX) level course. A practicum course cannot be delivered as a stand-alone course, cannot be combined with a CTS project course and cannot be used in conjunction with the Registered Apprenticeship Program or the Green Certificate Program.

Outcomes: The student will:

1. **perform assigned tasks and responsibilities, as required by the organization granting the credential(s) or articulation**
   - 1.1 identify regulations and regulatory bodies related to the credential(s) or articulation
   - 1.2 describe personal roles and responsibilities, including:
     - 1.2.1 key responsibilities
     - 1.2.2 support functions/responsibilities/expectations
     - 1.2.3 code of ethics and/or conduct
   - 1.3 describe personal work responsibilities and categorize them as:
     - 1.3.1 routine tasks; e.g., daily, weekly, monthly, yearly
     - 1.3.2 non-routine tasks; e.g., emergencies
     - 1.3.3 tasks requiring personal judgement
     - 1.3.4 tasks requiring approval of a supervisor
   - 1.4 demonstrate basic employability skills and perform assigned tasks and responsibilities related to the credential(s) or articulation
2. **analyze personal performance in relation to established standards**
   - 2.1 evaluate application of the attitudes, skills and knowledge developed in related CTS courses
   - 2.2 evaluate standards of performance in terms of:
     - 2.2.1 quality of work
     - 2.2.2 quantity of work
   - 2.3 evaluate adherence to workplace legislation related to health and safety
   - 2.4 evaluate the performance requirements of an individual who is trained, experienced and employed in a related occupation in terms of:
     - 2.4.1 training and certification
     - 2.4.2 interpersonal skills
     - 2.4.3 technical skills
     - 2.4.4 ethics

3. demonstrate basic competencies

3.1 demonstrate fundamental skills to:

- 3.1.1 communicate
- 3.1.2 manage information
- 3.1.3 use numbers
- 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:

- 3.2.1 demonstrate positive attitudes and behaviours
- 3.2.2 be responsible
- 3.2.3 be adaptable
- 3.2.4 learn continuously
- 3.2.5 work safely

3.3 demonstrate teamwork skills to:

- 3.3.1 work with others
- 3.3.2 participate in projects and tasks

4. create a transitional strategy to accommodate personal changes and build personal values

4.1 identify short-term and long-term goals

4.2 identify steps to achieve goals