



HEAVY DUTY EQUIPMENT TECHNICIAN

2017

Level 1 Based on the CCDA Harmonization Recommendations and
the Interprovincial Program Guide
(pg. 12 for Program Structure)



©Her Majesty the Queen in Right of Canada, 2017

Cat. No.: HS42-2/7-2008E

ISBN 978-1-100-10818-6

The Joint Planning Committee (JPC) recognizes this Interprovincial Program Guide as the national curriculum for the occupation of Heavy Duty Equipment Technician.

Acknowledgements

The Joint Planning Committee and the Interprovincial Program Guide Working Group wishes to acknowledge the contributions of the following industry and instructional representatives who participated in the development of this document.

Kevin Farrell	Newfoundland and Labrador
Chad Gill	Prince Edward Island
Keith Langenberger	Saskatchewan
Jason MacPhee	Nova Scotia
Robert Rice	Newfoundland and Labrador
Gordon Scott	New Brunswick
Shane Walters	Manitoba

In addition to the representatives above, various federal, provincial and territorial representatives contributed to the development of this document including Ken Jordan representing the host province of New Brunswick.

Table of Contents

Acknowledgements	2
Introduction	4
User Guide	5
IPG Glossary of Terms	7
Essential Skills Profiles	9
Profile Chart.....	10
Nova Scotia Program Structure	12

PROGRAM CONTENT

Level 1	13
Level 2.....	57
Level 3.....	84
Level 4.....	120
Nova Scotia Document Evaluation Form.....	138

Introduction

Jurisdictions have long recognized the benefit of pooling resources in the development and maintenance of apprenticeship training standards. A successful example of this is the Interprovincial Standards (Red Seal) program itself. Essential to the establishment of standards is the development of suitable training systems and programs which enable tradespeople to acquire certification based on these standards. While certification is the responsibility of Apprenticeship administrators throughout Canada, the development and delivery of technical training is the responsibility of jurisdictions.

In 1999, work to develop common training for apprenticeship programs within the Atlantic Provinces began. To date, 22 Curriculum Standards have been developed through the Atlantic Standards Partnership (ASP) project to assist programming staff and instructors in the design and delivery of technical training. Similarly, the Canadian Council of Directors of Apprenticeship (CCDA) embarked on a process for the development of national Interprovincial Program Guides (IPGs) for the Boilermaker, Carpenter and Sprinkler System Installer trades. At its January 2005 strategic planning session, the CCDA identified developing common training standards as one of key activities in moving towards a more cohesive apprenticeship system.

With the support of Human Resources and Social Development Canada (HRSDC), several provinces and territories have partnered to build on the ASP and the CCDA processes to further develop IPGs to be used across the country. This partnership will create efficiencies in time and resources and promote consistency in training and apprentice mobility.

User Guide

According to the Canadian Apprenticeship Forum, the Interprovincial Program Guide (IPG) is: "a list of validated technical training outcomes, based upon those sub-tasks identified as common core in the National Occupational Analysis, and validated by industry in the provinces and territories as incorporating the essential tasks, knowledge and skills associated with a given trade."

Learning outcomes contained in the IPG represent the minimum common core content for the development of jurisdictional training standards and outlines. IPGs are developed based on the National Occupational Analyses and extensive industry consultation. The IPG is intended to assist program development staff in the design of jurisdictional plans of training. Each jurisdiction has the flexibility to add additional content.

The IPG was deliberately constructed for ease of use and flexibility of structure in order to adapt to all delivery requirements. It details units of training, unit outcomes and objectives. It does not impose a delivery model or teaching format.

Jurisdictions and/or training providers will select and develop delivery materials and techniques that accommodate a variety of learning styles and delivery patterns. The IPG does not dictate study materials, textbooks or learning activities to be used in delivery.

The IPG document includes a recommended leveling structure to facilitate mobility for apprentices moving from one jurisdiction to another. Because of difference in jurisdictional regulations and program durations, levels are offered as suggestions only.

Structure

The content of the IPG is divided into units. Unit codes are used as a means of identification and are not intended to convey the order of delivery. Prerequisites have not been detailed. Jurisdictions are free to deliver units one at a time or concurrently provided all outcomes are met.

User Guide *(continued)*

The IPG does not indicate the amount of time to be spent on a particular unit. The length of time required to deliver an outcome successfully will depend upon the learning activities and teaching methods used. Jurisdictions are encouraged to use practical demonstration and opportunities for hands-on learning whenever possible.

The unit outcomes are the specific performances that must be evaluated. Wording of outcomes, "Demonstrate knowledge of...", acknowledges the broad spectrum of ways in which knowledge can be shown. It is at the discretion of each jurisdiction to determine the manner in which outcomes are evaluated; theoretically, practically or a combination of both.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided. Content may be added or extended in jurisdictional training plans.

IPG Glossary of Terms

These definitions are intended as a guide to how language is used in the IPGs.

ADJUST	To put in good working order; regulate; bring to a proper state or position.
APPLICATION	The use to which something is put and/or the circumstance in which you would use it.
CHARACTERISTIC	A feature that helps to identify, tell apart, or describe recognizably; a distinguishing mark or trait.
COMPONENT	A part that can be separated from or attached to a system; a segment or unit.
DEFINE	To state the meaning of (a word, phrase, etc.).
DESCRIBE	To give a verbal account of; tell about in detail.
DIAGNOSE	To analyze or identify a problem or malfunction.
EXPLAIN	To make plain or clear; illustrate; rationalize.
IDENTIFY	To point out or name objectives or types.
INTERPRET	To translate information from observation, charts, tables, graphs, and written material.
MAINTAIN	To keep in a condition of good repair or efficiency.
METHOD	A means or manner of doing something that has procedures attached to it.
OPERATE	How an object works; to control or direct the functioning of.
PROCEDURE	A prescribed series of steps taken to accomplish an end.

IPG Glossary of Terms *(continued)*

PURPOSE	The reason for which something exists or is done, made or used.
SERVICE	Routine inspection and replacement of worn or deteriorating parts. An act or business function provided to a customer in the course of one's profession. (e.g., haircut).
TEST	v. To subject to a procedure that ascertains effectiveness, value, proper function, or other quality. n. A way of examining something to determine its characteristics or properties, or to determine whether or not it is working correctly.

Essential Skills Profiles

Essential Skills are the skills needed for work, learning and life. They provide the foundation for learning all the other skills that enable people to evolve within their jobs and adapt to workplace change.

Over the past several years, the Government of Canada has conducted research examining the skills people use at work. From this research, Essential Skills Profiles have been developed for various occupations.

For more information regarding Essential Skills and to access Essential Skills Profiles for specific occupations, visit Human Resources and Social Development Canada's Essential Skills website at:

http://srv108.services.gc.ca/english/general/home_e.shtml

Profile Chart

OCCUPATIONAL SKILLS			
CHT-100 Safety	CHT-105 Tools and Equipment	CHT-110 Hoisting and Lifting	CHT-115 Communication and Documentation
CHT-125 Start, Move and Park Vehicle	CHT-130 Fasteners, Tubings, Hoses and Fittings	CHT-135 Lubrication and Fluids Servicing	CHT-140 Gaskets and Seals
CHT-145 Bearings	CHT-150 Metallurgy	CHT-155 Cutting and Heating	CHT-160 MIG Welding
CHT-200 SMAW Welding	CHT-120 Preventive Maintenance	HET-380 Fire Suppression Units	
ENGINES AND ENGINE SUPPORT SYSTEMS			
CHT-165 Engine Principles	CHT-167 Cooling Systems	CHT-170 Lubrication Systems	CHT-220 Non-Diesel Fuel Systems
CHT-225 Diesel Fuel Supply Systems	CHT-400 Diesel Fuel Injection Systems	CHT-405 Electronically-Controlled Diesel Fuel Systems	CHT-230 Intake and Exhaust Systems
CHT-425 Diesel Engine Overhaul	CHT-420 Base Engine Diagnostics	CHT-415 Engine Brakes and Retarders	CHT-410 Emission Control Systems
HYDRAULIC AND PNEUMATIC SYSTEMS			
CHT-183 Introduction to Hydraulics	CHT-185 Hydraulic Fittings, Piping, Tubing and Hoses	CHT-187 Reservoirs, Coolers and Filters	HET-300 Hydraulic Pumps and Motors
HET-305 Hydraulic Cylinders	HET-310 Control Valves	HET-315 Accumulators	HET-325 Hydraulic Systems Diagnostics and Testing
HET-385 Pneumatic Systems			

Profile Chart (continued)

DRIVE TRAIN			
CHT-205 Drive Lines	CHT-215 Engine Clutches	CHT-255 Automatic/Power Shift Transmissions	CHT-260 Torque Converters
CHT-210 Drive Axle Assemblies	HET-355 Final Drives	HET-340 Manual Transmissions and Power Take-offs	HET-350 Hydrostatic Drives
HET-345 Transfer Cases			
STEERING, SUSPENSION AND BRAKES			
CHT-193 Vehicle Hydraulic Brake Systems	CHT-163 Wheels, Tires and Rims	CHT-195 Basic Air Brakes	HET-335 Track-Type Undercarriage
HET-360 Power Assisted Steering Systems	HET-330 Front and Rear Suspensions	HET-370 Tracked Steering Systems	HET-365 Articulated Steering Systems
HET-320 Equipment Hydraulic Brake Systems			
ELECTRICAL AND ELECTRONIC SYSTEMS			
CHT-173 Electrical and Electronic Principles	CHT-175 Batteries	CHT-235 Starting Systems	CHT-240 Starting Aids
CHT-245 Charging Systems	CHT-250 Electronic Ignition Systems	CHT-177 Conventional Lighting Circuits	CHT-430 Gauges
CHT-180 Wiring Harnesses and Accessories	CHT-435 Vehicle Management Systems		
STRUCTURAL COMPONENTS, CLIMATE CONTROL, ACCESSORIES AND ATTACHMENTS			
CHT-265 Air Conditioning Systems	CHT-270 Heating and Ventilation Systems	HET-393 Winches, Wire Ropes and Accessories	HET-375 Cabs and Protective Structures
HET-390 Blades, Buckets and Cutting Edges	HET-395 Material Handling Equipment		

Nova Scotia Program Structure

CHT = Units common to Heavy Duty Equipment Technician & Truck and Transport Mechanic

HET = Units specific to Heavy Duty Equipment Technician

Nova Scotia Course No.	Nova Scotia Course Name	Nova Scotia Prerequisites	Interprovincial Program Guide (IPG) Content To Be Covered	
			IPG Units	Page #
Level 1 (8 Weeks) Common with Truck and Transport Mechanic				
MENT-1801	Integrated Milestone Workplace Mentoring I	None	MENT-1801 Workplace Mentoring I <i>(NS unit of instruction)</i>	
IMPA-0801	Fundamental Shop Skills	None	CHT-100 Safety	
			CHT-140 Gaskets, Seals and Sealing Compounds	
			CHT-145 Bearings	
			CHT-115 Communication & Documentation	
			CHT-105 Tools and Equipment	
			CHT-130 Fasteners, Tubings, Hoses and Fittings	
			CHT-110 Hoisting and Lifting	
IMPA-1803	Basic Electrical & Electronic Principles	IMPA-0801	CHT-173 Electrical & Electronic Principles	
			CHT-175 Batteries	
			CHT-177 Conventional Lighting Circuits	
			CHT-180 Wiring Harnesses and Accessories	
IMPA-1804	Hydraulics 1	IMPA-0801	CHT-183 Introduction to Hydraulics	
			CHT-185 Hydraulic Fittings, Piping, Tubing and Hoses	
			CHT-187 Reservoirs, Coolers and Filters	
IMPA-1805	Lubricants, Lubrication & Cooling	IMPA-0801	CHT-135 Lubrication and Fluids Servicing	
			CHT-167 Cooling Systems	
			CHT-170 Engine Lubrication Systems	
IMPA-1806	Braking Systems	IMPA-0801, 1804	CHT-190 Vehicle Hydraulic Brake Systems	
			HET-320 Equipment Hydraulic Braking Systems	
			CHT-195 Basic Air Brake Systems	
IMPA-1807	Engine Principles	IMPA-0801	CHT-165 Engine Principles	
MPOA-1800	Basic Welding	IMPA-0801	CHT-150 Metallurgy	
			CHT-155 Cutting and Heating	
			CHT-160 MIG Welding	
			CHT-200 SMAW Welding	
IMPA-1823	Wheel Assemblies and Preventive Maintenance	IMPA-0801	CHT-163 Tires, Rims and Wheels	
			CHT-120 Preventive Maintenance	

Nova Scotia Course No.	Nova Scotia Course Name	Nova Scotia Prerequisites	Interprovincial Program Guide (IPG) Content To Be Covered	
			IPG Units	Page #
Level 2 (7 Weeks) Common with Truck and Transport Mechanic				
IMPA-1808	Drive Lines	IMPA-0801	CHT-210 Drive Axle Assemblies CHT-205 Drive Lines	
IMPA-1809	Ignition Systems	IMPA-1803	CHT-250 Electronic Ignition Systems	
IMPA-1810	Fuel Systems 1	IMPA-0801	CHT-220 Non-Diesel Fuel Systems CHT-225 Diesel Fuel Supply Systems	
IMPA-1811	Intake & Exhaust Systems	IMPA-0801	CHT-230 Intake and Exhaust Systems	
IMPA-1812	Clutches & Manual Transmissions	IMPA-0801	CHT-215 Engine Clutches	
			HET-340 Manual Transmissions and Power Take-Offs	
			TTM-330 Manual Transmissions	
			TTM-335 Power Take-Offs	
			HET-345 Transfer Cases	
IMPA-1813	Starting & Charging Systems	IMPA-1803	CHT-235 Starting Systems	
			CHT-240 Starting Aids	
			CHT-245 Charging Systems	
IMPA-1820	HVAC Systems	IMPA-0801, 1803, 1804	CHT-265 Air Conditioning Systems CHT-270 Heating & Ventilation Sys	
Level 3 (6 Weeks)				
HDEA-1805	Pneumatics	IMPA-0801, 1803, 1804, 1805	HET-385 Pneumatic Systems	
HDEA-1804	Torque Converters & Powershift Transmissions	IMPA-1804, 1812	CHT-260 Torque Converters	
			CHT-255 Auto/ Power Shift Transmis	
			HET-300 Hydraulic Pumps	
HDEA-1801	Frame & Suspension Systems	IMPA-0801	HET-330 Front and Rear Suspensions	
			HET-335 Track-Type Undercarriage	
HDEA-1806	Hydraulics 2	IMPA-1804	HET-310 Control Valves	
			HET-305 Hydraulic Cylinders	
			HET-315 Accumulators	
			HET-350 Hydrostatic Drives	
			HET-325 Hydraulic Systems Diagnostic and Testing	
HDEA-1821	Steering Systems and Front End Alignment	HDEA-1801, 1806, IMPA-1804	HET-370 Tracked Steering Systems	
			HET-355 Final Drives	
			CHT-163 Tires, Rims and Wheels	
			HET-360 Power-Assisted Steering Sys	
			HET-365 Articulated Steering Systems	
			HDEA-1001 Manual Steering Systems (NS Specific)	
HDEA-1002 Front End Alignments (NS Specific)				

Nova Scotia Course No.	Nova Scotia Course Name	Nova Scotia Prerequisites	Interprovincial Program Guide (IPG) Content To Be Covered	
			IPG Units	Page #
HDEA-1822	Cabs, Equipment and Accessories	IMPA-0801, 1804	HET-393 Winches, Wire Ropes and Accessories	
			HET-395 Material Handling Equipment	
			HET-390 Blades, Buckets and Cutting Edges	
			HET-375 Cabs and Protective Structures	
			HET-380 Fire Suppression Units	
Level 4 (5 Weeks)				
MENT-1802	Integrated Milestone Workplace Mentoring II	MENT-1801	MENT-1802 Workplace Mentoring II <i>(NS unit of instruction)</i>	
HDEA-1815	Preventative Maintenance & Inspection	IMPA-1803, 1805, HDEA-1801, 1821	CHT-120 Preventive Maintenance	
			HDEA-1003 Pre-Delivery Inspection <i>(NS Specific)</i>	
HDEA-1816	Fuel Systems 2	IMPA-1804, 1810	CHT-405 Electronically-Controlled Diesel Fuel Injection Systems	
			CHT-400 Diesel Fuel Injection Systems	
HDEA-1817	Electronic Control & Monitoring Systems	IMPA-1803, 1816	CHT-410 Emission Control Systems	
			CHT-415 Engine Brakes and Retarders	
			CHT-430 Gauges	
			CHT-435 Vehicle Management Systems	
HDEA-1818	Engine Diagnosis	IMPA-1807	CHT-425 Diesel Engine Overhaul	
			CHT-420 Base Engine Diagnostics	
HDEA-1819	Program Review	Entire Program	HDEA-1819 Program Review <i>(NS Specific)</i>	
Nova Scotia Heavy Duty Equipment Technician Apprenticeship Program: All Courses are Required.				

LEVEL 1

MENT-1801

Workplace Mentoring I

(Nova Scotia Unit of Instruction)

Learning Outcomes:

- Identify and explain strategies for learning workplace skills.
- Demonstrate strategies to assist in learning skills in the workplace.

Objectives and Content:

1. Describe the importance of your own experiences.
2. Identify the partners involved in apprenticeship.
3. Describe the shared responsibilities for workplace learning.
4. Determine your own learning preferences and explain how these relate to learning new skills.
5. Describe the importance of different types of skills in the workplace.
6. Describe the importance of essential skills in the trade.
7. Identify different ways of learning.
8. Identify your learning preferences.
9. Identify different learning needs and strategies to meet learning needs.
10. Identify techniques for effective communication.
11. Identify strategies to assist in learning a skill.

Resource:

- Recommended resource to use in the delivery of this unit:
www.apprenticeship.nsc.ca/mentoring/apprentice.htm

CHT-100 Safety

Learning Outcomes:

- Demonstrate knowledge of safe work practices.
- Demonstrate knowledge of regulatory requirements pertaining to safety.
- Demonstrate knowledge of safety equipment, their applications and procedures for use.

Objectives and Content:

1. Identify types of personal protective clothing and equipment and describe their applications.
2. Describe the care and maintenance of personal protective equipment (PPE).
3. Identify workplace hazards and describe safe work practices.
 - i) personal
 - ii) shop/facility
 - fire
 - explosion
 - gases
 - electrical
 - housekeeping
 - awareness of surroundings
 - iii) environmental awareness
 - iv) vehicle/equipment
 - restraint systems
 - high voltage systems
 - high pressure systems
 - hydraulic
 - fuel
 - air
 - fire suppression systems
 - HVAC systems
4. Identify and explain workplace safety and health regulations.
 - i) federal
 - material safety data sheets (MSDS)

- ii)
 - workplace hazardous material information system (WHMIS) provincial/territorial
 - occupational health and safety (OHS)

Learning Outcomes:

- Demonstrate knowledge of gaskets, seals and sealing compounds, their applications and procedures for use.

Objectives and Content:

1. Define terminology associated with gaskets, seals and sealing compounds.
2. Identify hazards and describe safe work practices pertaining gaskets, seals and sealing compounds.
3. Identify specialty tools and equipment used to remove and install gaskets, seals and sealing compounds and describe their applications and procedures for use.
4. Identify types of gaskets and seals and describe their applications.
5. Identify types of sealing compounds and describe their applications.
 - i) room temperature vulcanizing
 - ii) anaerobic
6. Describe the procedures used to remove, fabricate and install gaskets.
7. Describe the procedures used to remove and install seals.
8. Describe the procedures used to apply sealing compounds.

CHT-145 Bearings

Learning Outcomes:

- Demonstrate knowledge of bearings and their applications.
- Demonstrate knowledge of the procedures to remove and install bearings.

Objectives and Content:

1. Define terminology associated with bearings.
2. Identify hazards and describe safe work practices pertaining to bearings.
3. Identify specialty tools and equipment used to remove and install bearings and describe their applications and procedures for use.
4. Identify types of bearings and describe their applications.
 - i) friction
 - ii) anti-friction
5. Describe bearing failure and its causes.
6. Describe the procedures used to remove and install bearings.
7. Describe the procedures used to lubricate and adjust bearings.

CHT-115 Communication and Documentation

Learning Outcomes:

- Demonstrate knowledge of effective communication practices.
- Demonstrate knowledge of trade related documentation.
- Demonstrate knowledge of vehicle identification codes.

Objectives and Content:

1. Describe the importance of effective communication.
 - i) customers
 - ii) co-workers
 - iii) related professionals
 - iv) journey person/apprentice

2. Locate and interpret identification codes found on the vehicle and vehicle components.

3. Identify and interpret types of service related documents.
 - i) work orders
 - ii) schematics and service information
 - iii) technical service bulletins (TSB)
 - iv) preventive maintenance schedules
 - v) parts lists
 - vi) time estimates

CHT-105 Tools and Equipment

Learning Outcomes:

- Demonstrate knowledge of hand and power tools, their applications, maintenance and procedures for use.
- Demonstrate knowledge of measuring tools, their applications, maintenance and procedures for use.
- Demonstrate knowledge of diagnostic tools, their applications and maintenance.
- Demonstrate knowledge of shop equipment, their applications, maintenance and procedures for use.

Objectives and Content:

1. Identify types of hand tools and describe their applications and procedures for use.
2. Describe the procedures used to store and maintain hand tools.
3. Identify types of power tools and describe their applications and procedures for use.
 - i) electric
 - ii) pneumatic
 - iii) hydraulic
4. Describe the procedures used to store and maintain power tools.
5. Identify types of measuring tools and describe their applications and procedures for use.
 - i) imperial
 - ii) metric
6. Identify types of diagnostic tools and describe their applications.
7. Describe the procedures used to store and maintain measuring and diagnostic tools.
8. Identify types of shop equipment and describe their applications and procedures for use.

9. Describe the procedures used to store and maintain shop equipment.

CHT-130

Fasteners, Tubings, Hoses and Fittings

Learning Outcomes:

- Demonstrate knowledge of fasteners, tubings, hoses and fittings, their applications and procedures for use.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to fasteners, tubings, hoses and fittings.
2. Identify specialty tools and equipment used to remove and install fasteners, tubings, hoses and fittings and describe their applications and procedures for use.
3. Identify types of fasteners and describe their applications and procedures for use.
4. Identify types of tubings and hoses and describe their applications and procedures for use.
5. Identify types of fittings and describe their applications and procedures for use.

CHT-110 Hoisting and Lifting

Learning Outcomes:

- Demonstrate knowledge of hoisting and lifting equipment, their applications and procedures for use.

Objectives and Content:

1. Define terminology associated with hoisting and lifting.
2. Identify hazards and describe safe work practices pertaining to hoisting and lifting.
3. Identify and interpret codes and regulations pertaining to hoisting and lifting.
4. Identify types of hoisting and lifting equipment and describe their applications, limitations and procedures for use.
 - i) vehicle
 - ii) component/equipment
5. Identify types of hoisting and lifting equipment accessories and describe their applications and procedures for use.
6. Describe the procedures used to inspect, store and maintain hoisting and lifting equipment and accessories.
7. Describe the procedures used to determine lift points and perform lifts.
8. Identify hand signals used to perform hoisting and lifting operations.

CHT-125

Start, Move and Park Vehicle

Learning Outcomes:

- Demonstrate knowledge of the procedures used to start-up, operate and shut-down equipment/vehicle.
- Demonstrate knowledge of the procedures used to prepare equipment/vehicle to be towed or pushed.
- Demonstrate knowledge of equipment/vehicle lock-out procedures.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to starting, moving and parking vehicles.
2. Describe the procedures used to start-up and shut down equipment/vehicles.
3. Describe the procedures used to operate equipment/vehicles.
4. Describe the procedures used to prepare equipment/vehicles to be towed or pushed.
5. Describe the procedures used to lock-out equipment/vehicles prior to servicing.

Learning Outcomes:

- Demonstrate knowledge of electrical and electronic principles.
- Demonstrate knowledge of the principles of magnetism.
- Demonstrate knowledge of electrical and electronic testing devices and their procedures for use.

Objectives and Content:

1. Define terminology associated with electricity, electronics and magnetism.
2. Identify hazards and describe safe work practices pertaining to electricity, electronics and magnetism.
3. Explain the principles of electricity and electronics.
4. Explain the principles of magnetism.
5. Describe Ohm's law and its applications.
6. Describe the procedures used to perform electrical-related calculations using Ohm's law.
7. Identify types of circuits and describe their characteristics and applications.
 - i) electrical
 - ii) electronic
 - programmable logic controls (PLCs)
 - non-programmable logic controls
8. Identify electrical components and describe their purpose and operation.
9. Identify electronic components and describe their purpose and operation.
 - i) diodes
 - ii) transistors
 - iii) capacitors
 - iv) resistors

10. Identify testing devices used to test circuits and describe their applications and procedures for use.
11. Identify and interpret information found on schematics.
12. Describe electrical malfunctions and their causes.
13. Describe the procedures used to test circuits.

CHT-175 Batteries

Learning Outcomes:

- Demonstrate knowledge of batteries and their operating principles.
- Demonstrate knowledge of the procedures used to service and test batteries.

Objectives and Content:

1. Define terminology associated with batteries.
2. Identify hazards and describe safe work practices pertaining to batteries.
 - i) personal
 - ii) shop/facility
 - iii) vehicle
3. Identify equipment used to test and recharge batteries and describe their applications and procedures for use.
4. Identify types of batteries and describe their applications, construction and operating principles.
5. Describe the procedures used to remove and install batteries.
6. Describe the procedures used to activate, maintain and store batteries.
 - i) maintenance free
 - ii) dry charge
 - iii) gel
7. Describe the procedures used to start engines with a battery booster.
8. Identify battery problems and describe the procedures used to diagnose and correct them.

Learning Outcomes:

- Demonstrate knowledge of conventional lighting circuits, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair conventional lighting circuits.

Objectives and Content:

1. Define terminology associated with conventional lighting circuits.
2. Identify hazards and describe safe work practices pertaining to conventional lighting circuits.
3. Identify specialty tools and equipment used to service and repair conventional lighting circuits and describe their applications and procedures for use.
4. Identify types of conventional lighting circuits and describe their components, purpose and operation.
 - i) high voltage
 - ii) low voltage
5. Interpret electrical symbols and wiring diagrams relating to conventional lighting circuits.
6. Describe the procedures used to inspect and maintain conventional lighting circuits and their components.
7. Identify conventional lighting circuit problems and their causes.
8. Describe the procedures used to diagnose conventional lighting circuits.
9. Describe the procedures used to remove and install conventional lighting circuit components.
10. Describe the procedures to repair conventional lighting circuits and components.

Learning Outcomes:

- Demonstrate knowledge of wiring harnesses and accessories, their purpose and operation.
- Demonstrate knowledge of the procedures used to service and repair wiring harnesses and accessories.

Objectives and Content:

1. Define terminology associated with wiring harnesses and accessories.
2. Identify hazards and describe safe work practices pertaining to wiring harnesses and accessories.
3. Identify specialty tools and equipment used to service and repair wiring harnesses and accessories and describe their applications and procedures for use.
4. Identify types of wiring harnesses and their components and describe their purpose and operation.
5. Identify types of wiring accessories and their components and describe their purpose and operation.
6. Interpret electrical symbols and wiring diagrams relating to wiring harnesses and accessories.
7. Describe the procedures used to inspect and maintain wiring harnesses and accessories and their components.
8. Identify wiring harness and accessory component problems and their causes.
9. Describe the procedures used to diagnose wiring harnesses and accessories.
10. Describe the procedures used to remove and install wiring harnesses and accessories and their components.

11. Describe the procedures used to repair wiring harnesses and accessories and their components.

CHT-183 Introduction to Hydraulics

Learning Outcomes:

- Demonstrate knowledge of the principles of hydraulics.
- Demonstrate knowledge of hydraulic components, their purpose and operation.
- Demonstrate knowledge of the procedures used to remove, install, service and maintain hydraulic components.

Objectives and Content:

1. Define terminology associated with hydraulics.
2. Identify hazards and describe safe work practices pertaining to hydraulics.
3. Explain the principles and theories of hydraulics.
 - i) Pascal's law
 - ii) Bernoulli's principle
4. Describe units of measure as they relate to hydraulics.
5. Identify hydraulic-related formulae and describe their applications.
6. Identify and interpret hydraulic-related symbols and abbreviations found on schematics.
7. Describe the properties of hydraulic fluids.
8. Identify tools and equipment used to remove, install, service and maintain hydraulic components and describe their applications and procedures for use.
9. Identify hydraulic components and describe their purpose, applications and operation.
 - i) pumps
 - positive displacement
 - non-positive displacement
 - fixed displacement
 - variable displacement
 - ii) actuators

- linear
 - rotary
 - iii) pressure control valves
 - iv) directional control valves
 - v) flow control valves
 - vi) accumulators
10. Describe the procedures used to remove and install hydraulic components.
11. Describe the procedures used to service and maintain hydraulic components.

Learning Outcomes:

- Demonstrate knowledge of hydraulic fittings, piping, tubing and hoses, their characteristics and applications.
- Demonstrate knowledge of the procedures used to maintain hydraulic fittings, piping, tubing and hoses.
- Demonstrate knowledge of the procedures used to remove and install hydraulic fittings, piping, tubing and hoses.

Objectives and Content:

1. Define terminology associated with hydraulic fittings, piping, tubing and hoses.
2. Identify hazards and describe safe work practices pertaining to hydraulic fittings, piping, tubing and hoses.
3. Identify specialty tools and equipment used to remove and install hydraulic fittings, piping, tubing and hoses and describe their applications and procedures for use.
4. Identify types of hydraulic fittings and describe their characteristics and applications.
5. Identify types of hydraulic piping and tubing and describe their characteristics and applications.
6. Identify types of hydraulic hoses and describe their characteristics and applications.
7. Describe the procedures used to inspect and maintain hydraulic fittings, piping, tubing and hoses.
8. Describe the procedures used to remove and install hydraulic fittings, piping, tubing and hoses.

Learning Outcomes:

- Demonstrate knowledge of reservoirs, coolers and filters, their applications and operation.
- Demonstrate knowledge of the procedures used to service and repair reservoirs, coolers and filters.

Objectives and Content:

1. Define terminology associated with reservoirs, coolers and filters.
2. Identify hazards and describe safe work practices pertaining to reservoirs, coolers and filters.
3. Identify specialty tools and equipment used to service and repair reservoirs, coolers and filters and describe their applications and procedures for use.
4. Identify types of reservoirs and describe their characteristics and applications.
 - i) vented
 - ii) pressurized
5. Identify reservoir components and describe their purpose and operation.
6. Identify types of coolers and filters and describe their characteristics and applications.
7. Identify cooler and filter components and describe their purpose and operation.
8. Describe the procedures used to inspect and maintain reservoirs, coolers and filters and their components.
9. Identify reservoir, cooler and filter problems and describe their causes.
10. Describe the procedures used to diagnose reservoirs, coolers and filters and their components.

11. Describe the procedures used to remove and install reservoirs, coolers and filters and their components.
12. Describe the procedures used to repair reservoirs and coolers and their components.

Learning Outcomes:

- Demonstrate knowledge of lubricants and fluids, their characteristics and applications.
- Demonstrate knowledge of the procedures to lubricate vehicle/equipment components.
- Demonstrate knowledge of the procedures for lubrication and fluid servicing.

Objectives and Content:

1. Define terminology associated with lubrication and fluids servicing.
2. Identify hazards and describe safe work practices pertaining to lubrication and fluid servicing.
 - i) personal
 - ii) equipment
 - iii) environmental
3. Identify specialty tools and equipment used for lubrication and fluid servicing and describe their applications and procedures for use.
4. Identify types of lubricants and fluids and describe their applications.
5. Identify the properties and characteristics of lubricants and fluids.
6. Identify types of filters and describe their characteristics and applications.
7. Describe the procedures used to check lubricant and fluid levels and condition.
8. Describe the procedures used to sample fluids.
9. Describe the procedures used to change fluids and filters.
10. Describe the procedures used to lubricate vehicle/equipment components.
11. Identify types of automatic lubrication systems and describe their purpose and operation.

12. Describe the procedures used to service and maintain automatic lubrication systems.
13. Describe the procedures used to handle, store and dispose of lubricants and fluids.

CHT-167 Cooling Systems

Learning Outcomes:

- Demonstrate knowledge of engine cooling systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair cooling systems.

Objectives and Content:

1. Define terminology associated with cooling systems.
2. Identify hazards and describe safe work practices pertaining to cooling systems and their components.
3. Identify specialty tools and equipment used to service and repair cooling systems and describe their applications and procedures for use.
4. Identify types of cooling systems and describe their applications and operation.
 - i) liquid-cooled
 - ii) air-cooled
5. Identify cooling system components and describe their purpose and operation.
6. Identify types of cooling system fluids and describe their characteristics and applications.
7. Describe the procedures used to handle and dispose of cooling system fluids.
8. Identify cooling system fluid tests and describe their associated procedures.
9. Describe the procedures used to service cooling systems.
10. Describe the procedures used to inspect and maintain cooling systems and components.
11. Identify cooling system problems and their causes.

12. Describe the procedures used to diagnose cooling systems and components.
13. Describe the procedures used to remove and install cooling system components.
14. Describe the procedures used to repair cooling systems and components.

CHT-170 Engine Lubrication Systems

Learning Outcomes:

- Demonstrate knowledge of engine lubrication systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair engine lubrication systems.

Objectives and Content:

1. Define terminology associated with engine lubrication systems.
2. Identify hazards and describe safe work practices pertaining to engine lubrication systems.
3. Identify types of engine lubrication systems and describe their applications and operation.
4. Identify engine lubrication system components and describe their purpose and operation.
5. Describe the procedures used to inspect and maintain engine lubrication systems and components.
6. Identify engine lubrication system failures and their causes.
7. Describe the procedures used to diagnose engine lubrication systems and components.
8. Describe the procedures used to remove and install engine lubrication system components.
9. Describe the procedures used to disassemble and assemble engine lubrication system components.
10. Describe the procedures used to repair engine lubrication systems and components.

Learning Outcomes:

- Demonstrate knowledge of vehicle hydraulic brake systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair vehicle hydraulic brake systems.

Objectives and Content:

1. Define terminology associated with vehicle hydraulic brake systems.
2. Identify hazards and describe safe work practices pertaining to vehicle hydraulic brake systems.
3. Identify specialty tools and equipment used to service and repair vehicle hydraulic brake systems and describe their applications and procedures for use.
4. Identify types of vehicle hydraulic brake systems and describe their applications and operation.
 - i) drum
 - ii) disc
5. Identify vehicle hydraulic brake system components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain vehicle hydraulic brake systems and their components.
7. Identify vehicle hydraulic brake system problems and their causes.
8. Describe the procedures used to diagnose vehicle hydraulic brake systems.
9. Describe the procedures used to remove and install vehicle hydraulic brake system components.
10. Describe the procedures used to repair and adjust vehicle hydraulic brake systems and their components.

Learning Outcomes:

- Demonstrate knowledge of equipment hydraulic brake systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair equipment hydraulic brake systems.

Objectives and Content:

1. Define terminology associated with equipment hydraulic brake systems.
2. Identify hazards and describe safe work practices pertaining to equipment hydraulic brake systems.
3. Identify specialty tools and equipment used to service and repair equipment hydraulic brake systems and describe their applications and procedures for use.
4. Identify types of equipment hydraulic brake systems and describe their applications and operation.
 - i) drum
 - ii) disc
 - iii) multi-disc
5. Identify equipment hydraulic brake system components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain equipment hydraulic brake systems and their components.
7. Identify equipment hydraulic brake system problems and their causes.
8. Describe the procedures used to diagnose equipment hydraulic brake systems.
9. Describe the procedures used to remove and install equipment hydraulic brake systems components.

10. Describe the procedures used to adjust and repair equipment hydraulic brake systems and their components.

CHT-195 Basic Air Brake Systems

Learning Outcomes:

- Demonstrate knowledge of basic air brake systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair basic air brake systems.

Objectives and Content:

1. Define terminology associated with basic air brake systems.
2. Identify hazards and describe safe work practices pertaining to basic air brake systems.
3. Identify specialty tools and equipment used to service and repair basic air brake systems and describe their applications and procedures for use.
4. Identify types of basic air brake systems and describe their applications and operation.
 - i) air
 - ii) air over hydraulic
5. Identify basic air brake system components and describe their purpose and operation.
 - i) compressors
 - ii) reservoirs
 - iii) governors
 - iv) hoses, lines and fittings
 - v) air dryers
 - vi) foundation brakes
 - vii) brake chambers
 - viii) valves
 - ix) indicators and warning devices
6. Describe the procedures used to inspect and maintain basic air brake systems and components.

7. Identify basic air brake system problems and their causes.
8. Describe the procedures used to diagnose basic air brake systems.
9. Describe the procedures used to remove and install basic air brake system components.
10. Describe the procedures used to repair and adjust basic air brake system components.

CHT-165 Engine Principles

Learning Outcomes:

- Demonstrate knowledge of engine operating principles.
- Demonstrate knowledge of major engine components, their purpose and operation.

Objectives and Content:

1. Define terminology associated with engine principles.
2. Explain the principles and theories of engine operation.
3. Identify types and classifications of engines and describe their applications.
4. Identify major engine components and describe their purpose and operation.

CHT-150 Metallurgy

Learning Outcomes:

- Demonstrate knowledge of metals and their characteristics.
- Demonstrate knowledge of material testing procedures.

Objectives and Content:

1. Define terminology associated with metallurgy.
2. Identify types of metals and describe their properties.
 - i) ferrous
 - ii) non-ferrous
3. Identify common metal tests and describe their associated procedures.

CHT-155 Cutting and Heating

Learning Outcomes:

- Demonstrate knowledge of cutting and heating equipment and accessories.
- Demonstrate knowledge of the procedures used to cut and heat using oxy-fuel equipment.

Objectives and Content:

1. Define terminology associated with oxy-fuel cutting and heating.
2. Identify hazards and describe safe work practices pertaining to oxy-fuel cutting and heating.
 - i) personal
 - ii) shop/facility
 - awareness of surroundings
 - iii) equipment/vehicle
 - iv) ventilation
 - v) cutting and heating equipment
3. Identify and interpret codes and regulations pertaining to oxy-fuel cutting and heating.
4. Identify cutting and heating equipment and accessories and describe their applications.
 - i) oxy-fuel
 - ii) plasma-arc
5. Describe the procedures used to set-up, adjust and shut-down oxy-fuel equipment.
6. Describe the procedures used to inspect and maintain oxy-fuel equipment.
7. Describe the procedures used to transport and store oxy-fuel equipment.
8. Describe the procedures used to cut and heat material using oxy-fuel equipment.

9. Describe the procedures used to solder, braze and fuse using oxy-fuel equipment.

Learning Outcomes:

- Demonstrate knowledge of MIG welding equipment and accessories.
- Demonstrate knowledge of the procedures used to weld using MIG welding equipment.

Objectives and Content:

1. Define terminology associated with MIG welding.
2. Identify hazards and describe safe work practices pertaining to MIG welding.
 - i) personal
 - ii) shop/facility
 - awareness of surroundings
 - iii) equipment/vehicle
 - iv) ventilation
 - v) MIG equipment
3. Describe MIG welding processes and their applications.
 - i) Gas Metal Arc Welding (GMAW)
 - ii) Flux-Cored Arc Welding (FCAW)
4. Identify MIG welding equipment, consumables and accessories and describe their applications.
5. Describe the procedures used to set-up, adjust and shut-down MIG welding equipment.
6. Describe the procedures used to inspect and maintain MIG welding equipment.
7. Identify the types of welds performed using MIG welding equipment.
 - i) joints
 - ii) positions
8. Describe the procedures used to weld using MIG welding equipment.
9. Describe weld defects, their causes and prevention.

Learning Outcomes:

- Demonstrate knowledge of SMAW equipment and accessories.
- Demonstrate knowledge of the procedures used to weld using SMAW equipment.

Objectives and Content:

1. Define terminology associated with SMAW.
2. Identify hazards and describe safe work practices pertaining to SMAW.
 - i) personal
 - ii) shop/facility
 - awareness of surroundings
 - iii) equipment/vehicle
 - iv) ventilation
 - v) SMAW equipment
3. Identify and interpret codes and regulations pertaining to SMAW.
4. Describe the SMAW process and its application.
5. Identify SMAW equipment, consumables and accessories and describe their applications and storage requirements.
6. Describe the procedures used to set-up, adjust and shut-down SMAW equipment.
7. Describe the procedures used to inspect and maintain SMAW equipment.
8. Identify the types of welds performed using SMAW equipment.
 - i) joints
 - ii) positions
9. Describe the procedures used to weld using SMAW equipment.
10. Describe weld defects, their causes and prevention.

Learning Outcomes:

- Demonstrate knowledge of tires, rims and wheels, their characteristics and applications.
- Demonstrate knowledge of the procedures used to service and repair tires, rims and wheels.

Objectives and Content:

1. Define terminology associated with tires, rims and wheels.
2. Identify hazards and describe safe work practices pertaining to tires, rims and wheels.
3. Identify codes and regulations pertaining to tires, rims and wheels.
 - i) jurisdictional requirements
4. Identify specialty tools and equipment used to service and repair tires, rims and wheels and describe their applications and procedures for use.
5. Identify types of tires and describe their characteristics and applications.
 - i) on-road
 - radial
 - bias-ply
 - tube
 - tubeless
 - ii) off-road
 - loaded
 - non-loaded
6. Identify types of rims and wheels and describe their characteristics and applications.
7. Identify tire, rim and wheel components and accessories and describe their purpose.
8. Describe the procedures used to inspect and maintain tires, rims and wheels.

9. Describe the procedures used to remove and install tires, rims and wheels.
10. Describe the procedures used to repair tires, rims and wheels.
11. Describe the procedures used to balance wheels.

CHT-120 Preventive Maintenance

Learning Outcomes:

- Demonstrate knowledge of preventive maintenance and its purpose.
- Demonstrate knowledge of the procedures used to perform preventive maintenance.

Objectives and Content:

1. Define terminology associated with preventive maintenance.
2. Describe preventive maintenance programs.
 - i) scheduled lubrication
 - ii) scheduled servicing
 - iii) scheduled cleaning
 - iv) inspections (including pre-delivery)
 - v) completing documentation
 - vi) legal responsibilities
3. Describe the procedures used to perform preventive maintenance.

Level 2

Learning Outcomes:

- Demonstrate knowledge of drive axle assemblies, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair drive axle assemblies.

Objectives and Content:

1. Define terminology associated with drive axle assemblies.
2. Identify hazards and describe safe work practices pertaining to drive axle assemblies.
3. Identify specialty tools and equipment used to service and repair drive axle assemblies and describe their applications and procedures for use.
4. Identify types of drive axle assemblies and describe their applications and operation.
 - i) locking
 - ii) non-locking
 - iii) single reduction
 - iv) double reduction
 - v) planetary two-speed
 - vi) planetary double reduction
 - vii) double reduction two-speed
 - viii) power divider
5. Identify drive axle assembly components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain drive axle assemblies and their components.
7. Identify drive axle assembly problems and their causes.
8. Describe the procedures used to diagnose drive axle assemblies.

9. Describe the procedures used to remove and install drive axle assemblies and their components.
10. Describe the procedures used to repair and adjust drive axle assemblies.

CHT-205 Drive Lines

Learning Outcomes:

- Demonstrate knowledge of drive lines, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair drive lines.

Objectives and Content:

1. Define terminology associated with drive lines.
2. Identify hazards and describe safe work practices pertaining to drive lines.
3. Identify specialty tools and equipment used to service and repair drive lines and describe their applications and procedures for use.
4. Identify drive line configurations and describe their characteristics and operation.
5. Identify drive line components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain drive line components.
7. Identify drive line problems and their causes.
8. Describe the procedures used to diagnose drive lines.
9. Describe the procedures used to remove and install drive line components.
10. Describe the procedures used to repair and adjust drive line components.

Learning Outcomes:

- Demonstrate knowledge of electronic ignition systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair electronic ignition systems.

Objectives and Content:

1. Define terminology associated with electronic ignition systems.
2. Identify hazards and describe safe work practices pertaining to electronic ignition systems.
3. Identify specialty tools and equipment used to service and repair electronic ignition systems and describe their applications and procedures for use.
4. Identify types of electronic ignition systems and describe their operating principles.
5. Identify electronic ignition system components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain electronic ignition systems and components.
7. Identify electronic ignition system problems and their causes.
8. Describe the procedures used to diagnose electronic ignition systems and components.
9. Describe the procedures used to remove and install electronic ignition system components.
10. Describe the procedures used to repair and adjust electronic ignition systems and components.

Learning Outcomes:

- Demonstrate knowledge of non-diesel fuel systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair non-diesel fuel systems.

Objectives and Content:

1. Define terminology associated with non-diesel fuel systems.
2. Identify hazards and describe safe work practices pertaining to non-diesel fuel systems.
3. Identify the properties and characteristics of non-diesel fuels and describe the handling and storage procedures.
 - i) gasoline
 - ii) liquefied petroleum gas (LPG)
 - iii) compressed natural gas (CNG)
4. Identify specialty tools and equipment used to service and repair non-diesel fuel systems and describe their applications and procedures for use.
5. Identify non-diesel fuel system components and describe their purpose and operation.
 - i) tanks
 - ii) filters
 - iii) converters
 - iv) carburetors
 - v) valves
 - vi) gauges
 - vii) fuel lines and fittings
 - viii) pumps
6. Describe the procedures used to inspect and maintain non-diesel fuel systems and components.

7. Identify non-diesel fuel system problems and their causes.
8. Describe the procedures used to diagnose non-diesel fuel systems and components.
9. Describe the procedures used to remove and install non-diesel fuel system components.
10. Describe the procedures used to disassemble and assemble non-diesel fuel system components.
11. Describe the procedures used to repair and adjust non-diesel fuel systems and components.

Learning Outcomes:

- Demonstrate knowledge of diesel fuel supply systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair diesel fuel supply systems.

Objectives and Content:

1. Define terminology associated with diesel fuel supply systems.
2. Identify hazards and describe safe work practices pertaining to diesel fuel supply systems.
3. Identify the properties and characteristics of diesel fuels and describe their handling and storage procedures.
4. Identify specialty tools and equipment used to service and repair diesel fuel supply systems and describe their applications and procedures for use.
5. Identify diesel fuel supply system components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain diesel fuel supply systems and components.
7. Identify diesel fuel supply system problems and their causes.
8. Describe the procedures used to diagnose diesel fuel supply system and components.
9. Describe the procedures used to remove and install diesel fuel supply system components.
10. Describe the procedures used to disassemble and assemble diesel fuel supply system components.

11. Describe the procedures used to repair and adjust diesel fuel supply systems and components.

Learning Outcomes:

- Demonstrate knowledge of intake and exhaust systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair intake and exhaust systems.

Objectives and Content:

1. Define terminology associated with intake and exhaust systems.
2. Identify hazards and describe safe work practices pertaining to intake and exhaust systems.
3. Identify specialty tools and equipment used to service and repair intake and exhaust systems and describe their applications and procedures for use.
4. Identify types of air filtration systems and describe their applications and operation.
5. Identify intake system components and describe their purpose and operation.
6. Identify exhaust system components and describe their purpose and operation.
7. Describe the procedures used to inspect and maintain intake and exhaust systems and components.
8. Identify intake and exhaust system problems and their causes.
9. Describe the procedures used to diagnose intake and exhaust systems and components.
10. Describe the procedures used to remove and install intake and exhaust system components.
11. Describe the procedures used to repair intake and exhaust systems and components.

CHT-215 Engine Clutches

Learning Outcomes:

- Demonstrate knowledge of engine clutches, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair engine clutches.

Objectives and Content:

1. Define terminology associated with engine clutches.
2. Identify hazards and describe safe work practices pertaining to engine clutches.
3. Identify specialty tools and equipment used to service and repair engine clutches and describe their applications and procedures for use.
4. Identify types of engine clutches and describe their characteristics and operation.
 - i) single plate
 - ii) double plate
 - iii) over-center
5. Identify types of engine clutch actuating mechanisms and describe their principles of operation.
 - i) mechanical
 - ii) hydraulic
 - iii) pneumatic
6. Identify engine clutch components and describe their purpose and operation.
 - i) pressure plate assemblies
 - ii) release bearings
 - iii) pilot bearings
 - iv) brakes
 - v) flywheels
 - vi) housings
7. Describe the procedures used to inspect and maintain engine clutch components.
8. Identify engine clutch related problems and their causes.

9. Describe the procedures used to diagnose engine clutches.
10. Describe the procedures used to remove and install engine clutches and their components.
11. Describe the procedures to repair and adjust engine clutches and their components.

Learning Outcomes:

- Demonstrate knowledge of manual transmissions and power take-offs, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair manual transmissions and power take-offs.

Objectives and Content:

1. Define terminology associated with manual transmissions and power take-offs.
2. Identify hazards and describe safe work practices pertaining to manual transmissions and power take-offs.
3. Identify specialty tools and equipment used to service and repair manual transmissions and power take-offs and describe their applications and procedures for use.
4. Identify the types of manual transmissions and describe their applications and operation.
 - i) single counter-shaft
 - synchronized
 - non-synchronized
5. Identify manual transmission components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain manual transmissions and their components.
7. Identify manual transmission problems and their causes.
8. Describe the procedures used to diagnose manual transmissions.
9. Describe the procedures used to remove and install manual transmissions and their components.

10. Describe the procedures used to disassemble and assemble manual transmissions and their components.
11. Describe the procedures used to repair manual transmissions and their components.
12. Identify types of power take-offs and describe their components, purpose and operation.
13. Describe the procedures used to inspect and maintain power take-offs and their components.
14. Identify power take-off problems and their causes.
15. Describe the procedures used to diagnose power take-offs and their components.
16. Describe the procedures used to remove and install power take-offs and their components.
17. Describe the procedures used to adjust and repair power take-offs and their components.

Learning Outcomes:

- Demonstrate knowledge of manual transmissions, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair manual transmissions.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to servicing and repairing manual transmissions.
2. Identify specialty tools and equipment used to service and repair manual transmissions and describe their applications and procedures for use.
3. Identify types of manual transmissions and describe their applications and operation.
 - i) conventional manual shift
 - ii) electronic
 - iii) auto shift
4. Identify manual transmission components and describe their purpose and operation.
5. Describe the procedures used to disassemble and assemble manual transmissions and their components.
6. Describe the procedures used to inspect and maintain manual transmissions and their components.
7. Identify manual transmission problems and their causes.
8. Describe the procedures used to diagnose manual transmissions.
9. Describe the procedures used to remove and install manual transmissions and their components.

10. Describe the procedures used to repair manual transmissions and their components.

TTM-335 Power Take-offs

Learning Outcomes:

- Demonstrate knowledge of power take-offs, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair power take-offs.

Objectives and Content:

1. Define terminology associated with power take-offs.
2. Identify hazards and describe safe work practices pertaining to servicing and repairing power take-offs.
3. Identify specialty tools and equipment used to service and repair power take-offs and describe their applications and procedures for use.
4. Identify types of power take-offs and their components and describe their purpose and operation.
 - i) engine driven
 - front crankshaft
 - gear train
 - ii) transmission driven
 - iii) driveline driven
5. Describe the procedures used to disassemble and assemble power take-offs and their components.
6. Describe the procedures used to inspect and maintain power take-offs and their components.
7. Identify power take-off problems and their causes.
8. Describe the procedures used to diagnose power take-offs and their components.
9. Describe the procedures used to remove and install power take-offs and their components.

10. Describe the procedures used to adjust and repair power take-offs and their components.

Learning Outcomes:

- Demonstrate knowledge of transfer cases, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair transfer cases.

Objectives and Content:

1. Define terminology associated with transfer cases.
2. Identify hazards and describe safe work practices pertaining to transfer cases.
3. Identify specialty tools and equipment used to service and repair transfer cases and describe their applications and procedures for use.
4. Identify types of transfer cases and describe their applications and operation.
5. Identify transfer case components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain transfer cases and their components.
7. Identify transfer case problems and their causes.
8. Describe the procedures used to diagnose transfer cases.
9. Describe the procedures used to remove and install transfer cases and their components.
10. Describe the procedures used to overhaul and repair transfer cases and their components.

TTM-340 Transfer Cases

Learning Outcomes:

- Demonstrate knowledge of transfer cases, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair transfer cases.

Objectives and Content:

1. Define terminology associated with transfer cases.
2. Identify hazards and describe safe work practices pertaining to transfer cases.
3. Identify specialty tools and equipment used to service and repair transfer cases and describe their applications and procedures for use.
4. Identify types of transfer cases and describe their applications and operation.
5. Identify transfer case components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain transfer cases and their components.
7. Identify transfer case problems and their causes.
8. Describe the procedures used to diagnose transfer cases.
9. Describe the procedures used to remove and install transfer cases and their components.
10. Describe the procedures used to overhaul and repair transfer cases and their components.

CHT-235 Starting Systems

Learning Outcomes:

- Demonstrate knowledge of starting systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair starting systems.

Objectives and Content:

1. Define terminology associated with starting systems.
2. Identify hazards and describe safe work practices pertaining to starting systems.
3. Identify specialty tools and equipment used to service and repair starting systems and describe their applications and procedures for use.
4. Identify types of starting systems and describe their applications and operation.
 - i) electrical
 - ii) hydraulic
 - iii) pneumatic
5. Identify starting system components and describe their applications and operation.
6. Describe the procedures used to inspect and maintain starting system components.
 - i) electrical
 - ii) pneumatic
7. Identify starting system problems and their causes.
 - i) electrical
 - ii) pneumatic
8. Describe the procedures used to diagnose starting system components.
 - i) electrical
 - ii) pneumatic
9. Describe the procedures used to remove and install starting system components.

- i) electrical
 - ii) pneumatic
10. Describe the procedures used to repair starting system components.
- i) electrical
 - ii) pneumatic

Learning Outcomes:

- Demonstrate knowledge of starting aids, their purpose and operation.
- Demonstrate knowledge of the procedures used to service and repair starting aids.

Objectives and Content:

1. Define terminology associated with starting aids.
2. Identify hazards and describe safe work practices pertaining to starting aids.
3. Identify the types of starting aids and describe their purpose and operation.
 - i) ether starting systems
 - ii) oil heaters
 - iii) coolant heaters
 - iv) battery warmers
 - v) glow plugs
 - vi) intake manifold heaters
 - vii) decompression mechanisms
4. Describe the procedures used to inspect and maintain starting aids and their components.
5. Identify starting aid problems and their causes.
6. Describe the procedures used to diagnose starting aids and their components.
7. Describe the procedures used to remove and install starting aids and their components.
8. Describe the procedures used to repair starting aids and their components.

CHT-245 Charging Systems

Learning Outcomes:

- Demonstrate knowledge of charging systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair charging systems.

Objectives and Content:

1. Define terminology associated with charging systems.
2. Identify hazards and describe safe work practices pertaining to charging systems.
3. Identify specialty tools and equipment used to service and repair charging systems and describe their applications and procedures for use.
4. Identify charging system components and describe their purpose and operation.
5. Describe the procedures used to inspect and maintain charging system components.
6. Identify charging system problems and their causes.
7. Describe the procedures used to diagnose charging system components.
8. Describe the procedures used to remove and install charging system components.
9. Describe the procedures used to disassemble and assemble charging system components.
10. Describe the procedures used to repair charging system components.

Learning Outcomes:

- Demonstrate knowledge of air conditioning systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair air conditioning systems.

Objectives and Content:

1. Define terminology associated with air conditioning systems.
2. Identify hazards and describe safe work practices pertaining to air conditioning systems.
3. Identify codes and regulations pertaining to air conditioning systems.
 - i) certification requirements
4. Identify specialty tools and equipment used to service and repair air conditioning systems and describe their applications and procedures for use.
5. Describe the principles of refrigeration.
6. Identify refrigerant types and describe their characteristics and applications.
7. Identify and interpret information found on pressure/temperature charts.
8. Identify air conditioning system components and describe their purpose and operation.
9. Describe the procedures used to inspect and maintain air conditioning system and components.
10. Identify air conditioning system problems and their causes.
11. Describe the procedures used to diagnose air conditioning systems.

12. Describe the procedures used to remove and install air conditioning system components.
13. Describe the procedures used to repair and adjust air conditioning systems and components.

Learning Outcomes:

- Demonstrate knowledge of heating and ventilation systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair heating and ventilation systems.

Objectives and Content:

1. Define terminology associated with heating and ventilation systems.
2. Identify hazards and describe safe work practices pertaining to heating and ventilation systems.
3. Identify types of heating and ventilation systems and describe their applications and operation.
 - i) cab
 - ii) auxiliary
4. Identify heating and ventilation system components and describe their purpose and operation.
5. Describe the procedures used to inspect and maintain heating and ventilation systems and components.
6. Identify heating and ventilation system problems and their causes.
7. Describe the procedures used to diagnose heating and ventilation systems.
8. Describe the procedures used to remove and install heating and ventilation system components.
9. Describe the procedures used to repair and adjust heating and ventilation systems and components.

Level 3

Learning Outcomes:

- Demonstrate knowledge of pneumatic systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair pneumatic systems and components.

Objectives and Content:

1. Define terminology associated with pneumatic systems.
2. Identify hazards and describe safe work practices pertaining to pneumatic systems.
3. Explain the principles and theories of pneumatics.
 - i) Charles' law
 - ii) Boyle's law
4. Describe units of measure as they relate to pneumatics.
5. Identify pneumatic related formulae and describe their applications.
6. Identify and interpret pneumatic related symbols and abbreviations found on schematics.
7. Identify specialty tools and equipment used to service and repair pneumatic systems and describe their applications and procedures for use.
8. Identify types of pneumatic systems and describe their applications and operation.
 - i) portable air compressors
 - rotary
 - single-stage
 - two-stage
 - reciprocating
 - single-stage
 - two-stage

9. Identify pneumatic system components and describe their purpose and operation.
10. Describe the procedures used to inspect and maintain pneumatic systems and components.
11. Identify pneumatic system problems and their causes.
12. Describe the procedures used to diagnose pneumatic systems.
13. Describe the procedures used to remove and install pneumatic system components.
14. Describe the procedures used to adjust and repair pneumatic systems.

Learning Outcomes:

- Demonstrate knowledge of torque converters, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair torque converters.

Objectives and Content:

1. Define terminology associated with torque converters.
2. Identify hazards and describe safe work practices pertaining to torque converters.
3. Identify specialty tools and equipment used to service and repair torque converters and describe their applications and procedures for use.
4. Identify types of torque converters and describe their applications and operation.
5. Identify torque converter components and describe their purpose and operation.
 - i) impeller
 - ii) turbine
 - iii) stators
 - iv) split guide rings
 - v) flex plate
 - vi) lock-up clutches
 - vii) charge pump
 - viii) oil circuits
 - ix) valves
 - x) oil coolers
6. Describe the procedures used to inspect and maintain torque converters and their components.
7. Identify torque converter problems and their causes
8. Describe the procedures used to diagnose torque converters.

9. Describe the procedures used to remove and install torque converters and their components.
10. Describe the procedures used to repair and adjust torque converters and their components.

CHT-255 Automatic/Power Shift Transmissions

Learning Outcomes:

- Demonstrate knowledge of automatic/power shift transmissions, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair automatic/power shift transmissions.

Objectives and Content:

1. Define terminology associated with automatic/power shift transmissions.
2. Identify hazards and describe safe work practices pertaining to automatic/power shift transmissions.
3. Identify specialty tools and equipment used to service and repair automatic/power shift transmissions and describe their applications and procedures for use.
4. Identify types of automatic/power shift transmissions and describe their applications and operation.
 - i) hydromechanical
 - ii) electrohydraulic (electronically controlled)
5. Identify automatic/power shift transmission components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain automatic/power shift transmissions and their components.
7. Identify automatic/power shift transmission problems and their causes.
8. Describe the procedures used to diagnose automatic/power shift transmissions.
9. Describe the procedures used to remove and install automatic/power shift transmissions and their components.

10. Describe the procedures used to repair and adjust automatic/power shift transmissions and their components.

Learning Outcomes:

- Demonstrate knowledge of hydraulic pumps and motors, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair hydraulic pumps and motors.

Objectives and Content:

1. Define terminology associated with hydraulic pumps and motors.
2. Identify hazards and describe safe work practices pertaining to hydraulic pumps and motors.
3. Identify specialty tools and equipment used to diagnose and repair pumps and motors and describe their applications and procedures for use.
4. Identify classifications of hydraulic pumps and describe their characteristics, applications and operation.
 - i) non-positive displacement
 - ii) positive displacement
 - iii) fixed displacement
 - iv) variable displacement
5. Identify types of hydraulic pumps and describe their characteristics, applications and operation.
 - i) gear
 - ii) vane
 - iii) piston
6. Identify hydraulic pump components and describe their purpose and operation.
7. Describe the procedures used to inspect hydraulic pumps and their components.
8. Identify hydraulic pump problems and their causes.
9. Describe the procedures used to diagnose hydraulic pumps.

10. Describe the procedures used to repair hydraulic pumps and their components.
11. Identify classifications of hydraulic motors and describe their characteristics, applications and operation.
 - i) fixed displacement
 - ii) variable displacement
12. Identify types of hydraulic motors and describe their characteristics, applications and operation.
 - i) gear
 - ii) vane
 - iii) piston
13. Identify hydraulic motor components and describe their purpose and operation.
14. Describe the procedures used to inspect hydraulic motors and their components.
15. Identify hydraulic motor problems and their causes.
16. Describe the procedures used to diagnose hydraulic motors.
17. Describe the procedures used to repair and adjust hydraulic motors and their components.

Learning Outcomes:

- Demonstrate knowledge of front and rear suspensions, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair front and rear suspensions.

Objectives and Content:

1. Define terminology associated with front and rear suspensions.
2. Identify hazards and describe safe work practices pertaining to front and rear suspensions.
3. Identify specialty tools and equipment used to service and repair front and rear suspensions and describe their applications and procedures for use.
4. Identify the types of front and rear suspensions and describe their characteristics and applications.
 - i) on-road
 - ii) off-road
5. Identify front and rear suspension components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain front and rear suspension components.
7. Identify front and rear suspension problems and their causes.
8. Describe the procedures used to diagnose front and rear suspensions.
9. Describe the procedures used to remove and install front and rear suspension components.
10. Describe the procedures used to disassemble and assemble front and rear suspension components.

11. Describe the procedures used to adjust and repair front and rear suspensions and components.

Learning Outcomes:

- Demonstrate knowledge of track-type undercarriages, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair track-type undercarriages.

Objectives and Content:

1. Define terminology associated with track type undercarriages.
2. Identify hazards and describe safe work practices pertaining to track-type undercarriages.
3. Identify specialty tools and equipment used to service and repair track-type undercarriages and describe their applications and procedures for use.
4. Identify track-type undercarriage components and describe their purpose and operation.
5. Describe the procedures used to inspect and maintain track-type undercarriages and their components.
6. Identify track-type undercarriage problems and their causes.
7. Describe the procedures used to diagnose track-type undercarriages.
8. Describe the procedures used to remove and install track-type undercarriage components.
9. Describe the procedures used to adjust and repair track-type undercarriages and their components.

HET-310 Control Valves

Learning Outcomes:

- Demonstrate knowledge of control valves, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair control valves.

Objectives and Content:

1. Define terminology associated with control valves.
2. Identify hazards and describe safe work practices pertaining to control valves.
3. Identify specialty tools and equipment used to service and repair control valves and describe their applications and procedures for use.
4. Identify types of control valves and describe their characteristics and applications.
 - i) pressure control
 - ii) directional control
 - iii) volume control
5. Identify control valve components and describe their purpose and operation.
6. Identify the methods of valve actuation and describe their characteristics and applications.
7. Describe the procedures used to inspect and maintain control valves and components.
8. Identify control valve problems and their causes.
9. Describe the procedures used to diagnose control valves and components.
10. Describe the procedures used to remove and install control valves and components.

11. Describe the procedures used to disassemble and assemble control valves and components.
12. Describe the procedures used to adjust and repair control valves and their components.

Learning Outcomes:

- Demonstrate knowledge of hydraulic cylinders, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair hydraulic cylinders.

Objectives and Content:

1. Define terminology associated with hydraulic cylinders.
2. Identify hazards and describe safe work practices pertaining to hydraulic cylinders.
3. Identify specialty tools and equipment used to diagnose and repair hydraulic cylinders and describe their applications and procedures for use.
4. Identify types of hydraulic cylinders and describe their characteristics and applications.
5. Identify hydraulic cylinder components and describe their purpose and operation.
6. Describe the procedures used to inspect hydraulic cylinders and their components.
7. Identify hydraulic cylinder problems and their causes.
8. Describe the procedures used to diagnose hydraulic cylinders.
9. Describe the procedures used to disassemble and assemble hydraulic cylinders and their components.
10. Describe the procedures used to adjust and repair hydraulic cylinders and their components.

HET-315 Accumulators

Learning Outcomes:

- Demonstrate knowledge of accumulators, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair accumulators.

Objectives and Content:

1. Define terminology associated with accumulators.
2. Identify hazards and describe safe work practices pertaining to accumulators.
3. Identify specialty tools and equipment used to service and repair accumulators and describe their applications and procedures for use.
4. Identify the types of accumulators and describe their applications and operation.
 - i) gas charged
 - ii) spring-loaded
5. Identify accumulator components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain accumulators.
7. Identify accumulator problems and their causes.
8. Describe the procedures used to diagnose accumulators.
9. Describe the procedures used to remove and install accumulators and their components.
10. Describe the procedures used to disassemble, assemble and recharge accumulators.
11. Describe the procedures used to adjust and repair accumulators.

HET-350 Hydrostatic Drives

Learning Outcomes:

- Demonstrate knowledge of hydrostatic drives, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair hydrostatic drives.

Objectives and Content:

1. Define terminology associated with hydrostatic drives.
2. Identify hazards and describe safe work practices pertaining to hydrostatic drives.
3. Identify specialty tools and equipment used to service and repair hydrostatic drives and describe their applications and procedures for use.
4. Identify types of hydrostatic drives and describe their characteristics and operation.
 - i) open loop
 - ii) closed loop
5. Identify hydrostatic drive components and describe their purpose and operation.
 - i) pump
 - ii) motor
 - iii) charge pump
 - iv) filter
 - v) reservoir
 - vi) cooler
 - vii) valves
6. Describe the procedures used to inspect and maintain hydrostatic drives and their components.
7. Identify hydrostatic drive problems and their causes.
8. Describe the procedures used to diagnose hydrostatic drives and their components.

9. Describe the procedures used to remove and install hydrostatic drives and their components.
10. Describe the procedures used to disassemble and assemble hydrostatic drives and their components.
11. Describe the procedures used to adjust and repair hydrostatic drives and their components.

Learning Outcomes:

- Demonstrate knowledge of the procedures used to test and diagnose hydraulic systems.

Objectives and Content:

1. Define terminology associated with hydraulic system diagnostics and testing.
2. Identify hazards and describe safe work practices pertaining to hydraulic system diagnostics and testing.
3. Identify specialty tools and equipment used to diagnose and test hydraulic systems and describe their applications and procedures for use.
4. Describe the procedures used to test hydraulic systems and their components.
5. Describe the procedures used to diagnose hydraulic systems and components.
6. Interpret schematics and hydraulic diagrams.
7. Interpret hydraulic test and diagnostic data.

Learning Outcomes:

- Demonstrate knowledge of tracked steering systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair tracked steering systems.

Objectives and Content:

1. Define terminology associated with tracked steering systems.
2. Identify hazards and describe safe work practices pertaining to tracked steering systems.
3. Identify specialty tools and equipment used to service and repair tracked steering systems and describe their applications and procedures for use.
4. Identify types of tracked steering systems and describe their applications and operation.
5. Identify tracked steering system components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain tracked steering systems and their components.
7. Identify tracked steering system problems and their causes.
8. Describe the procedures used to diagnose tracked steering systems.
9. Describe the procedures used to remove and install tracked steering system components.
10. Describe the procedures used to adjust and repair tracked steering systems and components.

HET-355 Final Drives

Learning Outcomes:

- Demonstrate knowledge of final drives, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair final drives.

Objectives and Content:

1. Define terminology associated with final drives.
2. Identify hazards and describe safe work practices pertaining to final drives.
3. Identify specialty tools and equipment used to service and repair final drives and describe their applications and procedures for use.
4. Identify types of final drives and describe their applications and operation.
5. Identify final drive components and describe their purpose and operation.
6. Describe the procedures used to inspect and repair final drives and their components.
7. Identify final drive problems and their causes.
8. Describe the procedures used to diagnose final drives.
9. Describe the procedures used to remove and install final drive components.
10. Describe the procedures used to adjust and repair final drives and their components.

Learning Outcomes:

- Demonstrate knowledge of tires, rims and wheels, their characteristics and applications.
- Demonstrate knowledge of the procedures used to service and repair tires, rims and wheels.

Objectives and Content:

1. Define terminology associated with tires, rims and wheels.
2. Identify hazards and describe safe work practices pertaining to tires, rims and wheels.
3. Identify codes and regulations pertaining to tires, rims and wheels.
 - i) jurisdictional requirements
4. Identify specialty tools and equipment used to service and repair tires, rims and wheels and describe their applications and procedures for use.
5. Identify types of tires and describe their characteristics and applications.
 - i) on-road
 - radial
 - bias-ply
 - tube
 - tubeless
 - ii) off-road
 - loaded
 - non-loaded
6. Identify types of rims and wheels and describe their characteristics and applications.
7. Identify tire, rim and wheel components and accessories and describe their purpose.
8. Describe the procedures used to inspect and maintain tires, rims and wheels.

9. Describe the procedures used to remove and install tires, rims and wheels.
10. Describe the procedures used to repair tires, rims and wheels.
11. Describe the procedures used to balance wheels.

Learning Outcomes:

- Demonstrate knowledge of power-assisted steering systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair power-assisted steering systems.

Objectives and Content:

1. Define terminology associated with power-assisted steering systems.
2. Identify hazards and describe safe work practices pertaining to power-assisted steering systems.
3. Identify specialty tools and equipment used to service power-assisted steering system components and describe their applications and procedures for use.
4. Identify power-assisted steering system components and describe their applications and operation.
5. Describe the procedures used to inspect and maintain power-assisted steering systems and their components.
6. Describe the procedures to diagnose power-assisted steering systems and their components.
7. Describe the procedures used to remove and install power-assisted steering system components.
8. Describe the procedures used to disassemble and assemble power-assisted steering system components.
9. Describe the procedures used to adjust and repair power-assisted steering system components.

HET-365

Articulated Steering Systems

Learning Outcomes:

- Demonstrate knowledge of articulated steering systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair articulated steering systems.

Objectives and Content:

1. Define terminology associated with articulated steering systems.
2. Identify hazards and describe safe work practices pertaining to articulated steering systems.
3. Identify specialty tools and equipment used to service and repair articulated steering systems and describe their applications and procedures for use.
4. Identify the types of articulated steering systems and describe their applications and operation.
5. Identify articulated steering system components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain articulated steering systems and components.
7. Identify articulated steering system problems and their causes.
8. Describe the procedures used to diagnose articulated steering systems and their components.
9. Describe the procedures used to remove and install articulated steering system components.
10. Describe the procedures used to disassemble and assemble articulated steering system components.

11. Describe the procedures used to adjust and repair articulated steering systems and components.

Learning Outcomes:

- Demonstrate knowledge of manual steering systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair manual steering systems.

Objectives and Content:

1. Define terminology associated with manual steering systems.
2. Identify hazards and describe safe work practices pertaining to manual steering systems.
3. Identify specialty tools and equipment used to service manual steering system components and describe their applications and procedures for use.
4. Identify manual steering system components and describe their applications and operation.
5. Describe the procedures used to inspect and maintain manual steering systems and their components.
6. Describe the procedures to diagnose manual steering systems and their components.
7. Describe the procedures used to remove and install manual steering system components.
8. Describe the procedures used to disassemble and assemble manual steering system components.
9. Describe the procedures used to adjust and repair manual steering system components.

Learning Outcomes:

- Demonstrate knowledge of the procedures used to perform front end alignments.

Objectives and Content:

1. Define terminology associated with front end alignments.
2. Identify hazards and describe safe work practices pertaining to front end alignments.
3. Identify specialty tools and equipment used to perform front end alignments and describe their applications and procedures for use.
4. Describe the procedures used to perform basic wheel alignments.
5. Identify steering linkages and components requiring operational checks.
 - i) steering box
 - ii) tie rod ends
 - iii) centre link
 - iv) idler arms
 - v) pitman arms
 - vi) king pins
6. Describe wheel alignment problems, their causes and the procedures to prevent and correct them.
 - i) pull to one side
 - ii) tire wear
 - iii) improper wheel track
7. Describe the procedures to service electronically controlled steering.

Learning Outcomes:

- Demonstrate knowledge of winches, wire ropes and accessories, their characteristics and applications.
- Demonstrate knowledge of the procedures used to service and repair winches, wire ropes and accessories.

Objectives and Content:

1. Define terminology associated with winches, wire ropes and accessories.
2. Identify hazards and describe safe work practices pertaining to winches, wire ropes and accessories.
3. Identify specialty tools and equipment used to service and repair winches and describe their applications and procedures for use.
4. Identify the types of winches and describe their applications and operation.
 - i) mechanical
 - ii) hydraulic
 - iii) electric
5. Identify winch components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain winches and their components.
7. Identify winch problems and their causes.
8. Describe the procedures used to diagnose winches.
9. Describe the procedures used to remove and install winches and their components.
10. Describe the procedures used to disassemble and assemble winches and their components.

11. Describe the procedures used to adjust and repair winches and their components.
12. Identify the types of wire ropes and describe their characteristics and applications.
13. Identify winch and wire rope accessories and describe their applications and procedures for use.
 - i) fittings
 - ii) clamps
 - iii) wedges
 - iv) hooks
 - v) thimbles
14. Describe the procedures used to remove and install wire ropes and accessories.
15. Describe the procedures used to inspect and maintain wire ropes and accessories.
16. Identify wire rope problems and their causes.

HET-395

Material Handling Equipment

Learning Outcomes:

- Demonstrate knowledge of material handling equipment, its purpose and operation.
- Demonstrate knowledge of the procedures used to service and repair material handling equipment.

Objectives and Content:

1. Define terminology associated with material handling equipment.
2. Identify hazards and describe safe work practices pertaining to material handling equipment.
3. Identify specialty tools and equipment used to service and repair material handling equipment and describe their applications and procedures for use.
4. Identify the types of material handling equipment and describe their applications and operation.
 - i) construction related
 - ii) mining related
 - iii) forestry related
 - iv) industrial related
5. Identify material handling equipment attachments and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain material handling equipment and attachments.
7. Identify material handling equipment problems and their causes.
8. Describe the procedures used to diagnose material handling equipment.
9. Describe the procedures used to remove and install material handling equipment attachments and components.
 - i) booms

- ii) excavator attachments
 - iii) circle bearings
 - iv) swing gearing
10. Describe the procedures used to adjust and repair material handling equipment.

Learning Outcomes:

- Demonstrate knowledge of blades, buckets and cutting edges, their purpose and operation.
- Demonstrate knowledge of the procedures used to service and repair blades, buckets and cutting edges.

Objectives and Content:

1. Define terminology associated with blades, buckets and cutting edges.
2. Identify hazards and describe safe work practices pertaining to blades, buckets and cutting edges.
3. Identify types of blades and describe their construction and applications.
4. Identify blade components and describe their purpose and operation.
 - i) push arm
 - ii) pitch arm
 - iii) tilt arm
 - iv) pins
 - v) cutting edge
 - vi) corner edge
5. Describe the procedures used to inspect and maintain blades and their components.
6. Describe the procedures used to remove and install blades and their components.
7. Identify types of buckets and describe their characteristics and applications.
8. Identify bucket components and describe their purpose and operation.
 - i) cutting edges
 - ii) teeth
 - iii) shanks
 - iv) bushings
 - v) pins

9. Describe the procedures used to inspect and maintain buckets and their components.
10. Describe the procedures used to remove and install buckets and their components.
11. Identify types of quick-coupling attachments and describe their applications and procedures for use.
 - i) mechanical
 - ii) hydraulic
12. Describe the procedures used to inspect and maintain quick-coupling attachments.
13. Describe the procedures used to remove and install quick-coupling attachments.
14. Describe the procedures used to repair quick-coupling attachments.

Learning Outcomes:

- Demonstrate knowledge of cabs and protective structures, their purpose and operation.
- Demonstrate knowledge of the procedures used to service and repair cabs and protective structures.

Objectives and Content:

1. Define terminology associated with cabs and protective structures.
2. Identify hazards and describe safe work practices pertaining to cabs and protective structures.
3. Identify codes and regulations pertaining to protective structures.
4. Identify cab components and describe their purpose and operation.
5. Describe the procedures used to remove and install cab components.
6. Describe the procedures used to inspect and maintain cab components.
7. Describe the procedures used to repair cab components.
8. Identify types of protective structures and describe their purpose.
 - i) roll-over protective structures (ROPS)
 - ii) falling-object protective structures (FOPS)
9. Describe the procedures used to remove and install protective structures.
10. Describe the procedures and limitations for protective structure repair.

Learning Outcomes:

- Demonstrate knowledge of fire suppression units, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair fire suppression units.

Objectives and Content:

1. Define terminology associated with fire suppression units.
2. Identify hazards and describe safe work practices pertaining to fire suppression units.
3. Identify codes and regulations pertaining to fire suppression units.
4. Identify specialty tools and equipment used to service and repair fire suppression units and describe their applications and procedures for use.
5. Identify types of fire suppression units and describe their applications and operation.
 - i) manual
 - ii) automatic
6. Identify fire suppression unit components and describe their purpose and operation.
7. Describe the procedures used to inspect and maintain fire suppression units.
8. Describe the procedures used to remove and install fire suppression units.
9. Describe the procedures used to repair fire suppression units.

Level 4

MENT-1802

Workplace Mentoring II (Nova Scotia Unit of Instruction)

Learning Outcomes:

- Identify and explain strategies for teaching workplace skills.
- Demonstrate strategies to assist in teaching skills in the workplace

Objectives and Content:

1. Describe the impact of your own experiences in teaching skills.
2. Identify the different roles played by a workplace mentor.
3. Describe the six-step approach to teaching skills.
4. Explain the importance of identifying the point of the lesson.
5. Identify how to choose a good time to present a lesson.
6. Explain the importance of linking the lessons.
7. Identify the components of the skill (the context).
8. Describe considerations for demonstrating a skill.
9. Identify types of skill practice.
10. Describe considerations in setting up opportunities for skill practice.
11. Explain the importance of providing feedback.
12. Identify techniques for giving effective feedback.
13. Describe a skill assessment.
14. Identify methods of assessing progress.
15. Explain how to adjust a lesson to different situations.

Resources:

- Recommended resource to use in the delivery of this unit:
www.apprenticeship.nsc.ca/mentoring/apprentice.htm

CHT-120 Preventive Maintenance

Learning Outcomes:

- Demonstrate knowledge of preventive maintenance and its purpose.
- Demonstrate knowledge of the procedures used to perform preventive maintenance.

Objectives and Content:

1. Define terminology associated with preventive maintenance.
2. Describe preventive maintenance programs.
 - i) scheduled lubrication
 - ii) scheduled servicing
 - iii) scheduled cleaning
 - iv) inspections (including pre-delivery)
 - v) completing documentation
 - vi) legal responsibilities
3. Describe the procedures used to perform preventive maintenance.

HDEA-1003 Pre-Delivery Inspection

(Nova Scotia Unit of Instruction)

Learning Outcomes:

- Demonstrate knowledge of pre-delivery inspections and their purpose.
- Demonstrate knowledge of the procedures used to perform pre-delivery inspections.

Objectives and Content:

1. Identify the purpose of pre-delivery inspections.
2. Describe the procedures used to perform pre-delivery inspections.
 - i) inspection instructions
 - ii) specifications and tolerances documentation

Learning Outcomes:

- Demonstrate knowledge of electronically-controlled diesel fuel injection systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair electronically-controlled diesel fuel injection systems.

Objectives and Content:

1. Define terminology associated with electronically-controlled diesel fuel injection systems.
2. Identify hazards and describe safe work practices pertaining to electronically-controlled diesel fuel injection systems.
 - i) high voltage
 - ii) high pressure
3. Identify specialty tools and equipment used to service and repair electronically-controlled diesel fuel injection systems and describe their applications and procedures for use.
4. Identify types of electronically-controlled diesel fuel injection systems and describe their applications and operation.
5. Identify electronically-controlled diesel fuel injection system components and describe their purpose and operation.
 - i) inputs (sensors)
 - ii) outputs
 - iii) processors
6. Describe the procedures used to inspect and maintain electronically-controlled diesel fuel injection system components.
7. Identify electronically-controlled diesel fuel injection system problems and their causes.

8. Describe the procedures used to diagnose electronically-controlled diesel fuel injection systems and components.
9. Describe the procedures used to remove and install electronically-controlled diesel fuel injection system components.
10. Describe the procedures used to disassemble and assemble electronically-controlled diesel fuel injection system components.
11. Describe the procedures used to repair and adjust electronically-controlled diesel fuel injection system components.

Learning Outcomes:

- Demonstrate knowledge of diesel fuel injection systems, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair diesel fuel injection systems.

Objectives and Content:

1. Define terminology associated with diesel fuel injection systems.
2. Identify hazards and describe safe work practices pertaining to diesel fuel injection systems.
3. Identify specialty tools and equipment used to service and repair diesel fuel injection systems and describe their applications and procedures for use.
4. Identify types of diesel fuel injection systems and describe their applications and operation.
 - i) in-line pump
 - ii) distributor pump
 - iii) pressure/time
 - iv) unit injector
5. Identify diesel fuel injection system components and describe their purpose and operation.
6. Describe the procedures used to inspect and maintain diesel fuel injection system components.
7. Identify diesel fuel injection system problems and their causes.
8. Describe the procedures used to diagnose diesel fuel injection systems and components.
9. Describe the procedures used to remove and install diesel fuel injection system components.

10. Describe the procedures used to disassemble and assemble diesel fuel injection system components.
11. Describe the procedures used to repair and adjust diesel fuel injection system components.

Learning Outcomes:

- Demonstrate knowledge of emission control systems, their components, and operation.
- Demonstrate knowledge of the procedures used to service and repair emission control systems.

Objectives and Content:

1. Define terminology associated with emission control systems.
2. Identify hazards and describe safe work practices pertaining to emission control systems.
3. Identify and interpret codes and regulations pertaining to emission control.
4. Identify specialty tools and equipment used to service and repair emission control systems and describe their applications and procedures for use.
5. Identify types of emission control systems and describe their characteristics and applications.
 - i) reducing particulate matter
 - ii) reducing NO_x
 - iii) reducing CO and CO²
 - iv) reducing hydrocarbons
6. Identify emission control system components and describe their purpose and operation.
7. Describe the procedures used to inspect and maintain emission control system components.
8. Identify emission control system problems and their causes.
9. Describe the procedures used to diagnose emission control systems and components.

10. Describe the procedures used to remove and install emission control system components.
11. Describe the procedures used to adjust and repair emission control systems and components.
12. Describe the procedures used to test vehicle emission controls.

CHT-415 Engine Brakes and Retarders

Learning Outcomes:

- Demonstrate knowledge of engine brakes and retarders, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair engine brakes and retarders.

Objectives and Content:

1. Define terminology associated with engine brakes and retarders.
2. Identify hazards and describe safe work practices pertaining to engine brakes and retarders.
3. Identify specialty tools and equipment used to service and repair engine brakes and retarders and describe their applications and procedures for use.
4. Identify types of engine brakes and retarders and describe their applications and operation.
 - i) engine brakes
 - ii) exhaust brakes
 - iii) hydraulic retarders
 - iv) electric retarders
5. Identify engine brake and retarder components and describe their purpose and operation.
6. Identify engine brake and retarder problems and their causes.
7. Describe the procedures used to diagnose engine brakes and retarders and their components.
8. Describe the procedures used to remove and install engine brakes and retarders and their components.
9. Describe the procedures used to disassemble and assemble engine brakes and retarders.

10. Describe the procedures used to inspect, adjust and repair engine brakes and retarders and their components.

CHT-430 Gauges

Learning Outcomes:

- Demonstrate knowledge of gauges, their components and operation.
- Demonstrate knowledge of the procedures used to service and repair gauges.

Objectives and Content:

1. Define terminology associated with gauges.
2. Identify hazards and describe safe work practices pertaining to gauges.
3. Identify specialty tools and equipment used to service and repair gauges and describe their applications and procedures for use.
4. Identify types of gauges and their components and describe their purpose and operation.
5. Interpret electrical symbols and wiring diagrams relating to gauges.
6. Describe the procedures used to inspect and maintain gauges and their components.
7. Identify gauge problems and their causes.
8. Describe the procedures used to diagnose gauge circuits and their components.
9. Describe the procedures used to remove and install gauges and their components.
10. Describe the procedures to repair and calibrate gauge components.

Learning Outcomes:

- Demonstrate knowledge of vehicle management systems, their components and operation.
- Demonstrate knowledge of reprogramming software.
- Demonstrate knowledge of the procedures used to diagnose and repair vehicle management system components.

Objectives and Content:

1. Explain basic computer operation and its relationship to vehicle management systems.
2. Identify computer diagnostic systems and describe their components and operation.
3. Describe the networking of modules, multi-plexing and programmable logic controls (PLCs).
4. Identify and interpret diagnostic trouble codes (DTC).
5. Identify the parameters of inputs and outputs and describe their relationships.
6. Identify types of specialized tools and equipment used to diagnose network and electronic circuitry and describe their applications and procedures for use.
 - i) digital volt ohmmeter (DVOM)
 - ii) scopes
 - iii) probes
 - iv) break out boxes
 - v) scan tools
 - vi) laptops
7. Identify the methods to diagnose vehicle management systems and describe their associated procedures.
 - i) PLCs
 - ii) on-board diagnostic (OBD)
 - iii) laptop/scan tools

8. Identify methods used to access/transfer and reprogram software and describe their associated procedures.
 - i) CD/DVD
 - ii) Internet
 - iii) scan tool
 - iv) electronically erasable programmable read only memory (EEPROM)

9. Describe the procedures used to repair and replace vehicle management system components.

CHT-425 Diesel Engine Overhaul

Learning Outcomes:

- Demonstrate knowledge of the procedures used to overhaul diesel engines.

Objectives and Content:

1. Define terminology associated with diesel engine overhauling.
2. Identify hazards and describe safe work practices pertaining to diesel engine overhauling.
3. Identify specialty tools and equipment used for diesel engine overhauling and describe their applications and procedures for use.
4. Describe the procedures used to remove and install diesel engines.
5. Describe the procedures used to inspect engine mounting components for wear.
6. Describe the procedures used to disassemble and assemble diesel engines and components.
7. Describe the procedures used to clean and inspect diesel engines and their components.
8. Describe the procedures used to measure diesel engine components for wear.
9. Describe the procedures used to repair diesel engine components.
10. Describe the procedures used to commission diesel engines.

CHT-420 Base Engine Diagnostics

Learning Outcomes:

- Demonstrate knowledge of the procedures used to diagnose base engines and their components.

Objectives and Content:

1. Define terminology associated with base engine diagnostics.
2. Identify hazards and describe safe work practices pertaining to base engine diagnostics.
3. Identify specialty tools and equipment used to diagnose base engines and describe their applications and procedures for use.
4. Identify base engine problems and their causes.
5. Identify the methods of base engine diagnostics and describe their applications and associated procedures.
6. Interpret diagnostic test results to determine base engine problems.

HDEA-1819 Program Review

(Nova Scotia Unit of Instruction)

Learning Outcomes:

- Upon successful completion of this unit, the apprentice will complete a study plan based on the National Occupational Analysis.

Objectives and Content:

1. Identify areas of the program where knowledge of theory is weakest.
2. Identify areas where workplace experience is lacking or weak.
3. Identify resources necessary to address areas of shortfall.
4. Identify timelines to address areas of weakness.

Suggested Learning Activities:

1. Conduct a mock certification exam to be used for diagnostic purposes.
2. Review the National Occupational Analysis.
3. Review the Apprentice Logbook.
4. Review the Exam Preparation information found at www.nsapprenticeship.ca under Quick Links, Exam Preparation.
5. Conduct a final mock certification exam.

Resources:

These are the recommended resources to use in the delivery of this unit:

- Exam Preparation information, including videos, occupational analyses, exam counseling sheets, practice exams and sample questions, and other study materials and resources, can be found at www.nsapprenticeship.ca under Quick Links, Exam Preparation.
- Apprentice's personal logbook
- Applicable codes and regulations
- Program texts

Evaluation: pass/fail

Nova Scotia Document Evaluation Form

Thank you for your interest in the development and revision of this document. Upon review of the document, please record your feedback in relation to the following items:

- course division and organization
- relevancy of the content
- errors or omissions
- other suggestions for improvement and consideration

Overall comments are to be entered on this evaluation form and specific changes are to be entered directly on the document in the relevant area(s). When making proposed corrections(s) in the document, please use red ink. When all feedback has been recorded, return this evaluation form along with the document to the Apprenticeship Office noted at the bottom of the page.

(PLEASE PRINT)

Trade: Heavy Duty Equipment Technician

Full Name: _____

Type of Position: (Trade Practitioner, Instructor, etc.): _____

Company: _____

Address: _____

Telephone: _____

Comments: (Use a separate sheet of paper if necessary)

Return Evaluation Form and Document to:
Nova Scotia Apprenticeship Agency
1256 Barrington Street, 3rd Floor
PO Box 578
Halifax, NS B3J 2S9