



SAULT COLLEGE

COMBE OOTLIFIE

Course Title: Heavy Equipment I Theory
 Code No.: HED 101
 Program: Heavy Equipment Diesel
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Approved: *D. M. Cornish* Date: ___/___/___ \$3 / 0 0 <<



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Heavy Equipment I theory**I PHILOSOPHY/GOALS:**

The purpose of this program is to provide the student with a basic knowledge of equipment encountered in construction, forestry, mining and on-highway. Emphasis is put on shop safety, basic hand and power tools used in the trade, diesel engine construction and classification, clutches and manual transmissions, powertrains, traction controls and final drives

II STUDENT PERFORMANCE OBJECTIVES:

Upon successful completion of this course the student will:

Be able to describe the basic shop safety rules and regulations of most heavy equipment shops, use basic hand tools, special tools used in engine, transmission and differential overhaul and power tools needed in the heavy equipment trade.

Be able to overhaul a diesel engine, analyse the cause of engine failure and troubleshoot basic engine problems. Cooling and lubrication systems are covered in such a manner as to enable the student to analyze, field test and diagnose related problems with a minimum of test equipment.

Be able to analyse basic functions and operation of manual transmissions and clutches used in heavy equipment. The student will be able to understand the major parts and function of drivelines, differential and wheel final drives. He will also be able to dismantle most of these components.

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I PHILOSOPHY/GOALS:

The purpose of this program is to provide the student with a basic knowledge on crawler encountered in construction, forestry, mining and on-highway and rubber tired vehicles. Emphasis is put on the diesel engine, fuel injection, powertrains, hydraulic and electrical systems.

II STUDENT PERFORMANCE OBJECTIVES:

Upon successful completion of this course the student may enter the forestry, mining, construction or equipment dealer industries as a heavy equipment apprentice and in a few years become a qualified journeyman. Graduates of this program may also entered truck and coach or automotive apprenticeships.

III TOPICS TO BE COVERED:

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IV LEARNING ACTIVITIES:

Topic 1 Course Introduction and Policies

The student will be able to identify the college and the course policies. They will initiate to the college layout and to the heavy equipment area.

Learning Activities

- 1.1 Identify the college physical layout and Wing letter code.
- 1.2 Perform a college tour with the student.
- 1.3 Identify the technical trades layout.
- 1.4 Perform a department tour with the student.
- 1.5 Interpret the student rights.
- 1.6 Interpret the department policies and regulations.
 - Shop and classroom regulations
 - Timetables and schedules
 - Student evaluation procedures
 - Study skills
 - Scholarships/ Bursaries and Awards

Topic 2 What is Heavy Equipment

Learning Activities

- 2.1 Define "What is Heavy Equipment".
- 2.2 Name different types and classifications of heavy equipment.
- 2.3 Discuss the different types and classifications of heavy equipment.
- 2.4 Compare major types and classifications of heavy equipment.
- 2.5 List pre-operative and daily inspection and maintenance procedures.
- 2.6 Establish safe and correct operating procedures.
- 2.7 Locate and identify operating controls and instruments.

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IV LEARNING ACTIVITIES:

- 4.1.3 Explain the drill bits size.
 - Number drill bits
 - Letter drill bits
 - Fraction drill bits
- 4.1.4 Explain the difference between high and low speed drill bits.
- 4.1.5 Explain how lubricant is important when drilling holes.
- 4.1.6 Explain how to drill hole properly by using a center punch.
- 4.1.7 Explain how to re-center a hole with a chisel.
- 4.1.8 Explain how to sharpen a drill bits.
 - Point angle
 - Lip clearance
 - Web clearance
- 4.2.0 Taps and dies
- 4.2.1 Explain the need for taps and dies.
- 4.2.2 Explain and demonstrate various type of tap.
 - Taper tap
 - Plug tap
 - Bottoming tap
 - Machine screw tap
 - Pipe tap
- 4.2.3 Explain and demonstrate how to thread a drilled hole.
- 4.2.4 Explain and demonstrate different type of dies.
- 4.2.5 Explain the procedure for threading with die.
- 4.2.6 Define the thread terminology:
 - O N C and N C
 - O N P and N P
 - N T P and N P S
- 4.2.7 Explain and demonstrate thread gauges.
- 4.3.0 Helicoil **and** Keen sert
- 4.3.0 Explain the purpose of helicoil and keen sert.
- 4.3.2 Distinguish the difference between helicoil and keen sert.
- 4.3.3 Demonstrate how to install helicoil and keen sert.

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XV LEARNING ACTIVITIES:

- 4.3.4 Distinguish the major advantage and disadvantage of helicoil and keen sert.

Topic 5 Fasteners

The student will learn the importance of fasteners and they will learn how to recognize different type of fasteners.

Learning Activities

- 5.1 Explain why fasteners are widely used.
- 5.2 Define the different type and quality of fasteners.
- 5.3 Explain the difference between bolt and capscrew.
- 5.4 Explain the difference between rolled and cut thread.
- 5.5 Explain the major type of threads.
U N C and U H F
U N E F and U N P T
- 5.6 Define the mechanical advantage by using coarse and fine threads.
- 5.7 Explain the different ways to identify cap screws.
The length
The diameter
The thread
The grade
- 5.8 Explain different types of nuts and their functions.
- 5.9 Explain different types of washers and their functions.
- 5.10 Explain different types of set screws and their functions.
- 5.11 Explain different types of keys and keyways and their functions.
- 5.13 Explain different types of pins and their functions.

Topic 6 Measuring Instruments

The student will learn how to recognise the type of measuring instruments used in the heavy equipment trade. They will learn how to use them and how to take care of these expensive tools.

Learning Activities

- 6.1.0 Feeler **Gauges**
- 6.1.1 Explain the function of feeler gauges.

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IV LEARNING ACTIVITIES:

- 6.1.2 Explain and demonstrate different type of filler gauges.
 - Standard gauges
 - Stepped gauges
 - Wire gauges etc...
- 6.1.3 Explain how to take care of feller gauges to keep it accurate.
- 6.1.4 Explain and demonstrate how to use different feller gauges.
- 6.2.0 Micrometers
- 6.2.1 Explain the function of micrometers.
- 6.2.2 Explain and demonstrate different type and parts of micrometers.
 - Inside micrometers
 - Outside micrometers
 - Depth micrometers
- 6.2.3 Explain and demonstrate how to use different micrometers.
- 6.2.4 Explain and practice on how to read standard and metric micrometers properly.
- 6.2.5 Explain how to take care of micrometers to keep it accurate.
- 6.3.0 Dial Indicator
- 6.3.1 Explain the function and the need of dial indicators.
- 6.3.2 Explain and practice on how to read and pre load dial indicators properly.
- 6.3.3 Explain and demonstrate different dial indicator bases.
- 6.3.4 Explain how to take care of dial indicators to keep it accurate.
- 6.4.0 Calipers
- 6.4.1 Define the function and the need for calipers.
- 6.4.2 Explain the different type of calipers.
 - Inside caliper
 - Outside caliper
 - Vernier caliper
 - Telescopic gauge
- 6.4.3 Explain and demonstrate different vernier calipers.

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IV LEARNING ACTIVITIES:

- 6.4.4 Explain and practice on how to read standard and metric vernier calipers properly.
- 6.4.5 Explain how to take care of calipers to keep it accurate.

Topic 7 W.H.M.I.S

The student will learn the regulations of the Workplace Hazardous Material Information System in place in Canada. They will learn how to recognize the hazardous material and the label system.

Learning Activities

- 7.1 Interpret the definition of W.H.M.I.S.
- 7.2 Explain the W.H.M.I.S. regulations and the manufacturer, employer and the employee responsibilities.
- 7.3 Describe the W.H.M.I.S. symbol.
- 7.4 Explain the structure of W.H.M.I.S.
 - The supplier labels
 - The work place labels
- 7.5 Describe the different class of hazardous materials and their symbols.
- 7.6 Explain the M.S.D.S. (Material Safety Data Sheet)
 - The 9 sections of the M.S.D.S.
 - The location of the M.S.D.S. at the work place.

Topic 8 fire gafet

The student will learn how to recognise the type of fire and how to prevent it. They will learn the type of fire extinguishers and how to use it. They will also learn the parts and operation of fire suppression system used as on heavy equipment.

Learning Activities

- 8.1 Explain the components of a fire.
- 8.2 Explain the classification of fire.
- 8.3 Explain Sault College Fire safety plan.
 - Operation of the fire alarm
 - Building evacuation in case of fire
 - False alarms
 - Fire drill
- 8.4 Identify the location of fire fighting equipment in the H.E.D area.

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IV LEARNING ACTIVITIES:

- 10.4 Locate and identify fork truck controls and instruments.
- 10.5 Establish safe operating practices.
- 10.6 List pre-operative and daily inspection and maintenance procedures.
- 10.7 Establish safe and correct procedures for installing chains and slings.
- 10.8 Interpret the law and their responsibilities.

Topic 11 Shoo Safety

Learning Activities

- 11.1 Discuss the potential health and safety hazards.
- 11.2 Locate and identify emergency safety equipment and safe handling procedures.
- 11.3 Establish desirable shop housekeeping practices.

Topic 12 Hand Tools

Learning Activities

- 12.1 Name different hand tools and power tools used in the repair of heavy equipment.
- 12.2 Identify different hand tools used in the repair of heavy equipment.
- 12.3 Explain the correct and safe use of hand tools and power tools.
- 12.4 Select the correct tools necessary to test, remove, replace, adjust and assemble components.
- 12.5 Identify hand and power tools in unsafe condition.

Topic 13 Shop Equipment and CI-nine Methods

Learning Activities

- 13.1.0 Shop Equipment
 - 13.1.1 Name shop equipment required for the service and repair of heavy equipment.
 - 13.1.2 Identify shop equipment used for the service and repair of heavy equipment.

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IV LEARNING ACTIVITIES:

- 13.1.3 Explain the safe and correct procedures required when using and maintaining shop equipment.
- 13.2.0 Cleaning Methods
- 13.2.1 Name different cleaning methods.
- 13.2.2 Describe different cleaning methods.
- 13.2.3 Establish safe and correct cleaning procedures.

Topic 14 finqjffl* Fundamentals

The student will learn basic engine operation and types. They will also learn the different applications of those engine types.

Learning Activities

- 14.1 Give a short history on engine development.
- 14.2 Explain the difference between internal and external combustion engines.
- 14.3 Describe basic engine terminology.
- 14.4 Explain engine cycles.
- 14.5 Explain the elements of engines.
- 14.6 Describe the difference between rotary and reciprocating engines.
- 14.7 Describe and discuss the different engine arrangements.

Topic 15 Engine Claaaification

The student will be able to establish the advantages and disadvantages between spark and compression ignition engines. They will be able to name the different engine classifications and their purposes.

Learning Activities

- 15.1 Define the two basic use of engines.
 - Stationary equipment
 - Mobile equipment
- 15.2 Define the main difference between spark and compression ignition engine.
 - Method of supplying fuel
 - Compression ratio
 - Design of engine parts
 - Grade of fuel

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IV LEARNING ACTIVITIES:

- 15.3 Define the different way to classify engines.
By cycle By cooling system
By ignition method By valve arrangement
By cylinder arrangement By Displacement
By engine speed
- 15.4 Explain the definition 'Bore' 'Stroke' ^Displacement and their relationship to power development.
- 15.5 Explain the definition 'Compression ratio'.

TOPIC 16 Engine Crankshaft and Camshaft

The student will be able to recognize the principal parts of a crankshaft, a camshaft and their functions. They will be able to find the T.D.C. on an engine and the relationship between engine crankshaft/camshaft timing in the engine cycle.

Learning Activities

- 16.1.0 Crankshaft
- 16.1.1 Explain and discuss the five functions of the crankshaft.
- 16.1.2 Define and describe the principal parts of a crankshaft and their functions.
- 16.1.3 Explain and discuss crankshaft arrangements and it's effect on the engine.
- 16.1.4 Explain special crankshaft arrangements like offset crankshaft throws.
- 16.1.5 Explain and discuss crankshaft fatigue.
- 16.1.6 Explain and discuss the major crankshaft failures.
- 16.1.7 Explain and demonstrate how to find top dead center of an engine without using special tools.
- 16.2.0 **Camshaft**
- 16.2.1 Explain and discuss the four main camshaft functions.
- 16.2.2 Explain and describe the principal parts of a camshaft and their functions.
- 16.2.3 Explain and discuss the different camshaft lobe and their effect on the engine performance.
- 16.2.4 Explain and discuss the major causes of camshaft wear and failures.

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IV LEARNING ACTIVITIES:

- 16.3.0 Crankshaft and Camshaft Timing
- 16.3.1 Explain and demonstrate the relationship between the crankshaft and camshaft timing.
Two stroke cycle engine
Four stroke cycle engine
- 16.3.2 Explain on-engine crankshaft and camshaft timing arrangement and the location of the pistons in a four and six cylinder engine.

Topic 17 Sfiriyiti- Bearing

The student will be able to list the different engine bearings and their applications. They will be able to list the different material and describe the principal characteristic of the engine bearings.

Learning Activities

- 17.1 Explain the difference between bushing and bearing.
- 17.2 Explain the bearing lubrication wedging action.
- 17.3 Explain different bearing construction and discuss their applications.
- 17.4 Explain and discuss the engine bearing requirements.
- 17.5 Explain the two most popular type of bearing locks and discuss their applications.
- 17.6 Explain and discuss the importance of the bearing crush and bearing spread..
- 17.7 Explain the early signs of bearing failure and how to recognize it.
- 17.8 Explain and demonstrate how to install a crankshaft and it's bearings properly.
- 17.9 Explain the two different types of connecting rod big-ends.

Topic 18 crankshaft Balancing Force and Flywheel

The student will be able to list the different engine crankshaft balancing forces and their effect on the engine performance. They will be able to describe the function and the operation of an engine flywheel.

Learning Activities

- 18.1.0 Engine balancers and Dampers

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IV LEARNING ACTIVITIES:

- 18.1.1 Explain the unbalancing forces in an engine and discuss their effect.
 - Inertia force
 - Centrifugal force
- 18.1.2 Explain and demonstrate the different type of engine crankshaft balancers.
 - Balancer shaft
 - Lanchester balancers
- 18.1.3 Explain how the engine balancers cancel the unbalancing force of an engine.
- 18.1.4 Explain the causes and the effects of vibration on the crankshaft.
- 18.1.5 Explain and demonstrate the different type of vibration dampers and discuss their different application.
 - Viscous type
 - Rubber type
 - Spring type
- 18.2.0 Engine flywheel
- 18.2.1 Explain the three major function of a flywheel.
- 18.2.2 Explain and discuss the two other function of a flywheel on certain engine.
- 18.2.3 Explain and demonstrate how to inspect and service an engine flywheel.
- 18.2.4 Explain and discuss the proper installation of an engine flywheel.

Topic A9 Engine Liners and Cylinders Bores

The student will be able to describe different cylinder liners and their application They will be able to perform the proper cylinder liner and bore measurement.

Learning Activities

- 19.1 Explain the different types of cylinders.
- 19.2 Explain and discuss the liner construction and their application.
- 19.3 Explain the difference between the dry and wet liner.
- 19.4 Explain the difference between the slip-fit and the interference liner.

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IV LEARNING ACTIVITIES:

- 19.5 Explain and demonstrate cavitation and corrosion effect on liners.
- 19.6 Explain and demonstrate how to deglaze a liner properly.
- 19.7 Explain the importance of measuring the liner protrusion and demonstrate how to do it properly.
- 19.8 Explain how to measure liner wear and discuss the major liner failures.

Topic 20 Bncrine Pistons

The student will be able to describe the function of the engine piston and list the major part of the piston. They will be able to perform the proper piston measurement and analyze causes of piston failures.

Learning Activities

- 20.1 Describe the piston function in an engine.
- 20.2 Explain and describe the major piston parts.
- 20.3 Describe the major piston requirements and design.
- 20.4 Discuss different piston designs and their applications.
- 20.5 Explain the piston materials and construction.
- 20.6 Explain the piston cooling requirements and different method of cooling piston.
- 20.7 Explain and discuss different piston pin designs.
- 20.8 Explain and discuss the special piston designs.
 - Cross head pistons
 - Variable compression pistons
- 20.9 Explain and discuss major piston failures and the causes.
- 20.10 Discuss how to prevent piston failures.
- 20.10 Explain and demonstrate how to measure and repair pistons.

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IV LEARNING ACTIVITIES:

Topic 21 Engl!)* Piston Rings

The student will be able to describe the function of the engine piston rings and list the major types of rings. They will be able to perform proper piston rings measurements and analyze causes of piston ring failures.

Learning Activities

- 21.1 Explain the function of piston rings.
- 21.2 Explain and demonstrate the major type of piston rings.
Compression Rings
Oil control piston Rings
- 21.3 Explain various piston ring requirements.
- 21.4 Explain the different materials used in the construction of piston rings.
- 21.5 Explain and discuss the different piston rings end joints.
- 21.6 Discuss the different piston ring arrangement in different engines.
- 21.7 Explain and demonstrate the proper piston ring installation and measurements.
- 21.8 Discuss the major piston rings failures and on their causes.
- 21.9 Discuss how to prevent piston ring failures.

Topic 22 Engine Cylinder heads

The student will be able to describe the function of the engine cylinder head and list the major parts. They will be able to perform the proper measurements and analyze causes of cylinder head failures.

Learning Activities

- 22.1 Explain and describe the different type of cylinder heads encounter on diesel engines.
- 22.2 Explain and describe the most common cylinder head failures and problems.
- 22.3 Discuss the easiest way to detect and prevent cylinder head failures.

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IV LEARNING ACTIVITIES:

- 22.4 Explain and describe the proper way to service cylinder heads using different tools.
Valve spring compressor
Magnetic crack detector
Chemical crack detector
Pressure method of crack detection
Straight edge and feeler gauge

Topic 23 Intake and Exhaust valves

The student will be able to describe the function of the intake and exhaust valves in a diesel engine. They will be able to perform the proper measurement, and service of the valves and analyze causes of valves failures.

Learning Activities

- 23.1 Explain the function of intake and exhaust in the modern diesel engine.
- 23.2 Describe and explain the types of intake and exhaust valves.
- 23.3 Explain major valve parts terminology.
- 23.4 Explain and discuss the valve construction and requirement in different applications.
- 23.5 Explain and describe how the valves are cooled.
- 23.6 Explain the construction and the function of valve seats.
- 23.7 Explain the construction and the function of valve guides.
- 23.8 Explain and discuss the major valve failures.
- 23.9 Discuss how to prevent valve failures.
- 23.10 Explain and demonstrate the special tools required to service valves, valve guides, valve seats.
- 23.11 Explain and describe how to service valves, valve guides, and valve seats.
- 23.12 Explain the function and the operation of valve rotators.
- 23.13 Explain the function and the type of valve seal and shield. Explain the difference between valve seal and valve shield.

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IV LEARNING ACTIVITIES:

Topic 24 Engine Combustion

The student will be able to describe the function of different combustion chamber and list the major type of combustion chambers.

Learning Activities

- 24.1 Explain the importance of the combustion chamber for proper engine performance and fuel economy.
- 24.2 Explain different type of combustion chambers.
 - Open or direct combustion chamber
 - Closed or indirect combustion chamber
 - M type combustion chamber
 - Energy cell, etc....
- 24.3 Explain different open combustion chambers, also the advantages and disadvantages.
- 24.4 Explain different closed combustion chambers, also the advantages and disadvantages.

The student will be able to describe the function of engine oil and understand the classification acronyms. They will be able to describe the reasons for different oil viscosity and quality.

Learning Activities

- 25.1 Explain the four main function of the engine oil and review the lubrication wedging action.
- 25.2 Explain the basic transformation of crude oil through refineries.
- 25.3 Explain and discuss the oil ratings and classifications.
 - S.A.E Rating
 - A.P.I Rating
 - M.I.L. Rating
 - Manufacturer Rating
 - A.S.T.M. Rating
- 25.4 Explain and discuss the oil viscosity.
 - Monograde
 - Multigrade
- 25.5 Explain and discuss the oil additives and their purposes in modern engine oil.
- 25.6 Describe the major oil contaminants.
- 25.7 Discuss the oil contamination prevention.

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IV LEARNING ACTIVITIES:

Topic 26 BiWJP" Lubrication System

The student will be able to describe the function of different lubrication and lubrication filtration system. They will be able to list the major part of the lubrication and the lubrication filtration systems and understand the importance of those systems.

Learning Activities

- 26.1 Explain and describe the different type of lubrication systems.
Circulation Splash System
Internal Full Feed and Splash
Full Internal Force Feed
- 26.2 Explain and describe the different lubrication pumps.
External gear type
Internal Gear Type
Rotor Type
- 26.3 Explain and describe the function and need of scavenge pumps in large diesel engine.
- 26.4 Explain how to inspect and service lubrication pumps.
- 26.5 Explain and describe the different lubrication filters.
- 26.6 Explain and discuss the degrees of filtration (Micron)
- 26.7 Explain and describe the different lubrication filtration systems.
Bypass System
Shunt System
Full Flow System
- 26.8 Explain and describe different auxiliary filtration systems and their needs.
- 26.9 Explain and describe the different lubrication valves and their functions in the lubrication system.
- 26.10 Explain the different oil coolers and their functions in the lubrication system.
- 26.11 Explain and describe the prelub system function and operation.

Topic 27 Engine Cooling System

The student will be able to describe the function of the engine cooling system. They will be able to list the major parts of the system and their functions.

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IV LEARNING ACTIVITIES:

Learning Activities

- 27.1 Explain the importance and the functions of a cooling system in modern diesel engine.
- 27.2 Explain and describe the different type of cooling systems.
 - Air Cooling System
 - Liquid Cooling System
- 27.3 Explain and discuss the advantages and disadvantages of those cooling systems.
- 27.4 Explain and describe the different type of liquid cooling systems.
 - Open Type
 - Close Type
- 27.5 Explain and describe the major parts of a liquid cooling system.
 - The radiator and radiator cap
 - The circulating pump
 - The cooling fan
 - The water jacket
 - The coolant conditioner
 - The heat exchanger
 - The thermostat
 - The cooling hoses
 - The coolant
- 27.6 Explain and describe different fan drives.
 - The viscous type
 - The air clutch type
 - The variable speed type
 - The electromagnetic type
- 27.7 Explain and describe the shutter function and operation.

Topic 28 **Bearings and Seals**

Learning Activities

28.1.0 **Bearings**

- 28.1.1 Name different types of bearings.
- 28.1.2 Describe their characteristics and construction.
- 28.1.3 Explain their function and operation.
- 28.1.4 Compare their operating characteristics.
- 28.1.5 Analyze bearing failures.

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IV LEARNING ACTIVITIES:

- 28.1.6 Determine safe and correct bearing adjustment procedures.
- 28.1.7 Determine safe and correct bearing removal, inspection and installation techniques.
- 28.1.8 Explain load forces on bearings.
- 28.1.9 Determine correct oils and greases required for bearings.
- 28.1.10 How to select the correct tools when working on bearings.
- 28.1.11 Establish general maintenance required for bearings.
- 28.2.0 Seals
- 28.2.1 Name different types of seals.
- 28.2.2 Describe their classifications and construction.
- 28.2.3 Explain their function and operation.
- 28.2.4 Compare their operating characteristics.
- 28.2.5 Analyze seal failures.
- 28.2.6 Establish safe and correct seal removal and installation procedure.

Topic 29 Gears and Gear Ratio's

Learning Activities

- 29.1.0 Gears
- 29.1.1 Name the different types and classifications of gears.
- 29.1.2 Describe the characteristics and construction of the different types of gears.
- 29.1.3 Explain the function and operation of each type of gear.
- 29.1.4 Compare the operation of different types of gears.
- 29.1.5 Select correct lubricant for different gear sets.
- 29.1.6 Explain gear terminology.
- 29.2.0 Gear Ratio's
- 29.2.1 Perform calculations applied to mechanical advantage, simple gear ratio and compound gear ratio.
- 29.2.2 Explain and discuss torque and speed ratio's.

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IV LEARNING ACTIVITIES:

Topic 30 Clutches

Learning Activities

- 30.1 Name the different types and classifications of clutches.
- 30.2 Explain the characteristics and construction features.
- 30.3 Describe the function and operation.
- 30.4 Distinguish the differences between types of clutches.
- 30.5 Compare the difference of each type of clutch.
- 30.6 Name the different types of clutch control mechanisms.
- 30.7 Describe the characteristics and construction of each control mechanism.
- 30.8 A) Explain the operation of each control mechanism.
B) Compare the operation of each control mechanism.
- 30.9 Establish safe and correct clutch adjustment procedures.
- 30.10 Outline a step by step trouble shooting procedure.
- 30.11 Explain the significance of correct clutch adjustment.
- 30.12 Explain the consequences of incorrect clutch adjustment.
- 30.13 Analyze clutch failures.

Topic 31 Manual Transmissions

Learning Activities

- 31.1 Name the types and classifications of manual transmissions.
- 31.2 Describe the characteristics and construction of each transmission type.
- 31.3 Explain the function and operation of each transmission type.
- 31.4 Compare the different transmissions.
- 31.5 Explain the power flow and operation of the internal working components.
- 31.6 Describe lubrication oil flow in the different transmissions.

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IV LEARNING ACTIVITIES:

31.7 Explain the significance of transmission oil levels and oil grades.

31.8 Explain the purpose of interlocks and detents.

Tonic 32 Manual Transmission Control Mechanisms

Learning Activities

32.1 Name the types of transmission control mechanisms.

32.2 Describe the characteristics and construction of transmission control mechanisms.

32.3 Explain the function and operation of transmission control mechanism.

32.4 Compare the function and operation of each transmission control mechanisms.

32.5 Establish a safe and correct adjustment procedure.

Tonic 33 Universal Joints And Constant Velocity Joints

Learning Activities

33.1 Name the different types.

33.2 Describe their construction and characteristics.

33.3 Explain their function and operation.

33.4 Compare the different operating characteristics of each.

33.5 Describe the safe and correct method on the removal, service and installation procedures.

33.6 Analyze component failures.

33.7 Establish maintenance and service intervals.

33.8 Explain the function and operation of slip joints.

33.9 Explain the function and operation of centre support bearings.

Topic 34 Drivelines

Learning Activities

34.1 Name the different classifications types of drivelines and their components.

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IV LEARNING ACTIVITIES:

- 34.2 Describe the construction and application of each.
- 34.3 Explain the function and operation of each driveline type.
- 34.4 Compare the different types of drivelines.
- 34.5 Explain the purpose of driveline balance.
- 34.6 Describe driveshaft balance procedure.
- 34.7 Explain the reason for driveshaft phasing.
- 34.8 Describe the method of driveshaft phasing.
- 34.9 Explain the need of driveline angles.
- 34.10 Interpret driveshaft angularity checks.
- 34.11 Identify incorrect driveline alignment.
- 34.12 Analyze component failures.

Topic 35 Differentials

Learning Activities

- 35.1 Name the main components of a simple differential.
- 35.2 Name the different classifications of differentials.
- 35.3 Describe the function and operation of each differential.
- 35.4 Compare the different operating characteristics of each differential.
- 35.5 Describe the safe and correct removal, disassembly, inspection, service, adjustment and installation procedures.
- 35.6 Explain and discuss axle and differential terminology.

Topic 36 Control Systems

Learning Activities

- 36.1 Name the different types of control systems.
- 36.2 Explain the characteristics and construction of each control system.
- 36.3 Describe the function and operation of each traction control device.

IV LEARNING ACTIVITIES:

Topic 37 Traction Controls

Learning Activities

- 37.1 Name the different types of traction controls.
- 37.2 Explain the characteristics and construction of each traction control device.
- 37.3 Describe the function and operation of each traction control device.
- 37.4 Compare the different operating characteristics of each traction control device.

Topic 38 Inter-Axle Differential

Learning Activities

- 38.1 Explain the purpose of a inter-axle differential,
- 38.2 Describe the operating characteristics and construction of a inter-axle differential.
- 38.3 Explain the function and operation of a inter-axle differential.
- 38.4 Define "wheel spin-out".

Topic 39 Wheel Planetary Drives

Learning Activities

- 39.1 Explain the purpose of wheel planetary drives.
- 39.2 Describe the characteristics and construction of wheel planetary drives.
- 39.3 Explain the operation of wheel planetary drives.

V. EVALUATION METHODS:

HED 101 assessment is based on regularly tests and assignments. Attendance and homework checks are recorded and used as an aid for counselling.

Heavy Equipment I theory

The following grades will be assigned.

A+	(>90%)	(Numerical Equivalent 4.0)	- Consistently Outstanding
A	(85-90%)	(Numerical Equivalent 3.75)	- Outstanding Achievement
B	(75-84%)	(Numerical Equivalent 3.00)	- Consistently Above Average Achievement
C	(65-74%)	(Numerical Equivalent 2.00)	- Satisfactory or Acceptable Achievement
R	(<65%)	(Numerical Equivalent 0.00)	- Repeat - Objectives of course not achieved and course must be repeated

CR - Credit exemption

X - A temporary grade, limited to situation with
extenuating circumstances, giving a student
additional time to complete course requirements.

Your Semester Theory Letter Grade will be comprised of:

- 80% of Semester Theory Exam Average
- 20% of Semester Theory Assignment Average

A 65% Average of the total semester exam and assignment must be achieved to receive a passing grade in Heavy Equipment Diesel Theory.

A student can not rewrite a test to improve his mark.

If a test is missed by a student, without a good reason, an "Incomplete" grade is allotted.

VI. REQUIRED STUDENT RESOURCES:

Textbooks:

Diesel Fundamentals (Second Edition) - Thiessen/Dales
Diesel Equipment I - Schulz

VII. ADDITIONAL RESOURCE MATERIALS AVAILABLE IN THE COLLEGE LIBRARY:

See Attached List

Periodical Section

Suggested list of periodicals in the Library which are of interest to Heavy Duty Equipment Students:

Heavy Construction News
Engineering & Contract Record
Northern Logger
Construction Methods & Equipment
Diesel Equipment Superintendent
Hydraulics and Pneumatics

Heavy Equipment I theory

Power
Bus and Truck Transport
Motor
E.M. (Heavy Duty "Equipment Maintenance")
Motor Truck
Diesel and Gas Turbine Progress

Audiovisual Section (Library Film Strip/Cassette Modules)

TJ 02a The crawler Tractor Operator Familiarization
TJ 02b Working The Crawler
TJ 03 Cummins Aneroids
TJ 04 Cummins Dial Indicator Tune-up
TJ 05 Cummins Piston Rings
TJ 06 Cummins PTD Fuel Injection
TJ 07 PTG AFC Theory and Operation
TJ 08 Diesel Truck History
TJ 09 Cummins Professional Driver Techniques
TJ 010 Drive Line Alignment
TJ 011 Driving With "Skid-Trol"
TJ 012 Introduction To Diesel
TJ 013 High Energy Ignition
TJ 014 Stopmaster Brake Troubleshooting
TJ 015 Oils For The 70's
TJ 016 Theory and Operation of Fluid Drive
TJ 017 VE Pump Operation

VII. SPECIAL NOTES:

High Top Safety Boots (CSA Approved)

Safety Glasses (CSA Approved), Impact on Prescription Lenses

Coloured Pencils (red, blue, green, yellow)

Students with special needs (eg. physical limitations, visual impairments, hearing impairments, learning disabilities) are encouraged to discuss required accommodations confidentially with their instructor. Your instructor reserves the right to modify the course as he/she deems necessary to meet the need of the students.