## SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

## SAULT STE. MARIE, ONTARIO

# COURSE OUTLINE

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|---|---|---|---|
| **COURSE TITLE:** | Heavy Equipment IV – Theory | | |
| **CODE NO. :** | HED210 | **SEMESTER:** | FOUR |
| **PROGRAM:** | Truck and Coach / Heavy Duty Equipment Technician | | |
| **AUTHOR:** | Lane Ross | | |
| **DATE:** | JAN 2011 | **PREVIOUS OUTLINE DATED:** | JAN 2010 |
| **APPROVED:** | *"Corey Meunier"* **CHAIR** | | **DATE** |
| **TOTAL CREDITS:** | 11 | | |
| **PREREQUISITE(S):** | HED200 | | |
| **HOURS/WEEK:** | 8 Hrs / 15 weeks | | |


***For additional information, please contact Corey Meunier, Chair***
***School of Technology & Skilled Trades***
***(705) 759-2554, Ext. 2610***

## I. COURSE DESCRIPTION:

This course will present hydrostatic transmission drive systems, air conditioning, hydrodynamic drives, vehicle braking and retarding systems and electronic engine management technology, along with emission controls encountered in the heavy equipment and trucking industries today. Safety elements of the repair industry will be stressed. Demonstrated skills learned in this semester will enable graduates to support the trucking, agricultural, construction, material handling, mining, forestry, railway and equipment rental and equipment dealership industries.

## II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

***1. Assess and support hydrostatic systems and circuits currently encountered in the commercial vehicle and equipment field.***

Potential Elements of the Performance:

- Interpret and follow hydrostatic schematic drawings.
- Identify type, construction, purpose and repair procedures for hydrostatic pumps and motors, charge pumps, crossover valves and related components.
- Predict possible failure and wear points within hydrostatic transmission circuits, determine the necessary diagnostic equipment to confirm the problem, and recommend the repair needed.

***2. Recognize and determine the maintenance and repair requirements and functions of conventional hydrodynamic drive systems.***

Potential Elements of the Performance:

- Distinguish between fluid couplings and torque converters.
- Determine phase and stage and flow paths internally and externally of a dry sump torque converter and a wet sump converter.
- Identify fixed, two phase and poly-phase torque converters correctly.
- Identify a countershaft, and planetary power shift transmission, determine torque paths, and internal, external hydraulic flow.
- Analyze the results of a torque converter stall test.
- Analyze the results of a hydraulic stall test and full hydraulic / converter stall test.

***3. Support the inspection, diagnostics, repair and / or replacement of commercial vehicle braking system components following the manufacturers procedures and guidelines. Students may also work toward an Ontario "Z" air brake endorsement certificate for successful completion of their air brake written and practical tests.***

Potential Elements of the Performance:

- Distinguish between drum and disc brake assemblies.
- Identify the fundamental operating principles of air brake components including all applicable valves, calliper assemblies, wedge brake assemblies and air over hydraulic, air booster assemblies.
- Interpret brake system schematics as applied to air brake systems.
- Identify manual and self-adjusting adjustment mechanisms in air brake systems.
- Determine the correct maintenance procedures and the proper tools required for support of vehicle braking systems.

***4. Recognize the various retarding systems and the required maintenance and adjustments needed to optimize their effectiveness and performance.***

Potential Elements of the Performance:

Classify, identify capacities, and operating fundamentals of vehicle retarding systems including engine compression brakes, exhaust brakes, hydraulic retarders and electrical retarders.

***5. Recognize, communicate with, and diagnose faults and maintain electronic engine and power train management systems.***

Potential Elements of the Performance:

- Distinguish between engine, drive train, hydraulic and overall vehicle microprocessor management.
- Identify advantages of electronic verses conventional engine fuel injection systems
- Categorize electronic devices into input, output or microprocessor hardware.
- Identify the fuel injection system, and their related components of: (a) partial authority systems (PEEC)
  (b) full authority systems
  -electronic unit injection
  -electronic unit pumps
  -hydraulically actuated electronic unit injection
  -high pressure injection (HPI-TP) Cummins
  -Cummins accumulator pump system
  -common rail systems

-rotary electronic injection pumps

- Identify analog and digital sensors and actuators and their operating principles.
- Follow diagnostic procedures using various computer software and troubleshooting flow charts and service manuals.
- Interpret active fault codes and logged events.
- Interpret programmed customer parameters.

***6. Ensure emission reducing devices are implemented, in working order and maintained to enhance the visual perception of diesel technology and the environment***

Potential Elements of the Performance:

- Identify both spark ignition and compression ignition engine exhaust emission make up.
- Distinguish the effect of ignition and injection timing, engine temperature, fuel quality, load, rpm and emission devices on diesel exhaust quality.
- Identify PCV, EGR, vapour capturing devices, air / fuel ratio control devices, and exhaust conditioning devices for modern day gas and diesel engines.
- Identify Cat ACERT engine emission management.

***7. Understand and explain Heavy Duty Air Conditioning System Fundamentals, troubleshoot and repair A/C Systems, evacuate and recharge A/C Systems as they apply to off road equipment and on road heavy-duty trucks. Identify the Environmental concern as it pertains to refrigerants and the destruction of the ozone layer.***

Potential Elements of the Performance

- Understand and explain the basic refrigeration cycle.
- Be able to identify all A/C components and explain their operation.
- Be able to evacuate an A/C System using approved methods according to government regulations and manufacturers specifications.
- Be able to recharge an A/C System using approved methods and according to government and manufacturers specifications.
- Understand and practice proper safety procedures as they apply to refrigerants.

**III. TOPICS:**

1. HYDROSTATICS
   - Hydrostatic Transmissions
   - Hydrostatic Diagnostics and Troubleshooting

2. HYDRODYNAMIC DRIVES
   - Fluid couplings
   - Torque Converters
   - Powershift Transmissions - Countershaft, Planetary
   - Stall Testing and Troubleshooting

3. VEHICLE BRAKING SYSTEMS
   - Air
   - Hydraulic (SAHR – Spring Applied Hydraulically Released)

4. VEHICLE RETARDING SYSTEMS
   - Engine Compression Systems (Jake Brake)
   - Exhaust Retarders
   - Hydraulic Retarders
   - Electric Retarders

5. ELECTRONIC ENGINE MANAGEMENT
   - Partial Authority Systems
     (I) PEEC
   - Full Authority (I) EUI systems
     (II) EUP systems
     (III) HEUI systems
     (IV) Cummins HPI - TP systems
     (V) Cummins Accumulator Pump system
     (VI) Common Rail systems
     (VII) Stanadyne rotary
     (VIII) Bosch rotary

6. EMISSION CONTROL SYSTEMS
   - Air / fuel Ratio Controls
   - Crankcase Ventilation
   - Evaporative Management
   - Catalytic Converters
   - Scrubbers and Filters
   - Exhaust Recirculation (EGR)
   - Cat ACERT Technology

7. AIR CONDITIONING SYSTEMS
    - Fundamentals of the refrigeration cycle.
    - Refrigerant types.
    - Compressor operation.
    - Condenser types and styles.
    - Expansion valves and fixed orifice systems.
    - Evaporator types and styles.
    - System design and layout.
    - Evacuation/Recharge Equipment.

## IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

- Heavy Duty Truck Systems 4th Edition (Thomson Delmar)
- Diesel Technology (Nelson Thompson)
- Diesel Technology Workbook
- Vickers Mobile Hydraulics Manual
- Power Trains (John Deere)

Pens, Pencils, Binder and Paper

## V. EVALUATION PROCESS/GRADING SYSTEM:

The Heavy Equipment Program considers both HED210-11 Theory and HED211-9 Shop to be *co-requisites.* Students must successfully complete both courses in the same semester.

Theory letter grades are based on; (also see attached information below)

- 70% of semester theory examination average
- 20% of semester theory assignment average
- 10% of assessed employability skills ( attendance, punctuality, work ethics, and general attitude)

A **60% Average of the total semester exam, assignments and employability skills** must be achieved to receive a passing grade of at least C in Theory.
A student **cannot rewrite** a test to improve his/her mark.
If a test is missed by a student, without a good reason, an **"Incomplete"** grade is allotted.

The following semester grades will be assigned to students:

| Grade | Definition | *Grade Point Equivalent* |
|---|---|---|
| A+ | 90 – 100% | 4.00 |
| A | 80 – 89% | |
| B | 70 - 79% | 3.00 |
| C | 60 - 69% | 2.00 |
| D | 50 – 59% | 1.00 |
| F (Fail) | 49% and below | 0.00 |

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|---|---|
| CR (Credit) | Credit for diploma requirements has been awarded. |
| S | Satisfactory achievement in field /clinical placement or non-graded subject area. |
| U | Unsatisfactory achievement in field/clinical placement or non-graded subject area. |
| X | A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course. |
| NR | Grade not reported to Registrar's office. |
| W | Student has withdrawn from the course without academic penalty. |

**Class and Shop Conduct – Motive Power Policies and Procedures**

The Heavy Equipment Program considers both HED210-11 Theory and HED211-9 Shop to be *co-requisites.* Students must successfully complete both courses in the same semester.

# Motive Power Department
# Truck/Coach-Heavy Equipment
# Department Policies and Procedures
## *Policy Information Sheet*

1. During your program, you are considered to be a member of the Motive Power Department. As such, your actions and deportment, both in the college and the community reflect on this Department. We trust that your influence will be positive.

2. College policy prohibits the consumption of food and drink in the classrooms and shop. Smoking is allowed only outside of the building in designated smoking areas. **No smokeless tobacco is allowed in theory class or shop class.**

3. CSA approved Safety Glasses and Safety Boots must be worn in the Shop at all times. This means going to and from all of the classrooms located in the shop. It is the responsibility of the **STUDENT** to wear them. You will be marked absent if the aforementioned policy is not adhered to.

**Note; All safety glasses and boots must meet Sault College CSA approval rating.**

See attachment RE: **Eye, Face and Foot Personal Protection Equipment (PPE)**

## NO GLASSES-NO BOOTS-NO ENTRY!!

4. Repairs to your private vehicles in our facilities can be educational to you. We will accommodate you if the work is part of our program and schedules in. **No car should be parked in the shop compound without staff permission and a temporary parking pass clearly displayed.**

5. **Attendance** – if late, don't bother coming until the next class, you will be marked absent. The student is to be continuously present and actively participating during all scheduled theory and shop classes (scheduled breaks excepted). For every unexcused absence you will be deducted 1% per class period missed from that specific unit for the time missed.

**6.** The student must have safety boots and safety glasses readily available because you may not have a lot of warning when going into shop.

**7.** Please, coffee breaks only 10 to 12 minutes MAXIMUM. **NOTE: Individual Professors will address each class with their expectations. Some may only allow 10 minutes.**

**8.** Please refrain from loitering in "C" wing hallways, around shop hallway entry doors and outside entrance doorways/walkways.

**9.** Drinking alcohol or using drugs at lunch is discouraged and students will be excused from class at the Professor's discretion.

**10.** Welding attendance is **MANDATORY, as are all related subjects.** It is in your best interests to attend all classes on your schedule. Remember, you need to successfully complete all assigned courses to graduate.

**11.** If you miss a test with an **"unexcused absence"** (as deemed legitimate by your professor) you will **NOT** be allowed to write that test. Only if; a doctors note, airline ticket, etc., or circumstances arising from a family emergency; and legitimate written proof can be presented to the professor. See item number 16 below for clarification.

**12.** If a class is missed or going to be missed it is your responsibility to notify in writing (see item #16 below) your Professor and make arrangements for handouts and notes taken while you are away.

**13.** **The use of cell phones/PDA's, electronic information/image capturing or recording device for any form of communication or recording (voice, text, recording, image, etc…) during theory class or shop is strictly prohibited. Cell phones/PDA's must be silenced during regular class and shop times *and must be turned off and kept out of sight during all classes and test sittings. Failure to follow the latter requirement during a test sitting will result in a grade of 0 (zero) being assigned and if not out of sight or being used during class, the unit WILL be confiscated for the duration of the class.***

***NO EXCEPTIONS***

**14.** Students may not wear earphones/headphones of any kind (i.e. for playback of recorded music/voice) during theory classes, shop classes and test sittings. This does not include hearing aids as required by hearing impaired students.

**15.** **NO Lap Top Computers** will be allowed in any class unless proper documentation is provided that the computer is required for learning assistance.

**16.** **Any request to deviate from the aforementioned course outline requirements must be made to the Professor in writing or via Sault College email. *If* permission is granted it must also be granted in writing or via Sault College email. Verbal requests/permissions are not acceptable. It is the student's responsibility to maintain a copy of all such requests and associated permissions.**

**Student Signature:_____**

**Date:_____**

**Students refusing to sign this form will not be allowed to register or continue in their course.**

# Guideline
# For
# Truck/Coach-Heavy Equipment

1. **ATTENDANCE**
A terminal objective of the Motive Power Department is the demonstration of satisfactory attendance and punctuality performance that the Motive Power Industry, itself, relies on, for efficiency, productivity and profitability.

- Absences will affect your learning and your final grade.

1.1 Students are encouraged to be present for the full duration of each class. Shop attendance is recorded at the start and end of class. Students are expected to be continuously present and actively participating (scheduled breaks excepted) for the entire class.

1.2 If you are absent from class at the time of attendance, you will be marked absent from the entire class.

1.3 If you are marked absent, and no reasonable excuse is given your absence will be termed unexcused. There should **NOT** be a reason to **NOT** let us know nor related subject Professors, in writing why you're absent.

1.4 Students will lose marks from their theory and shop mark grade for unexcused absences. Poor attendance can mean a repeat of both theory and shop courses if your employment skills are poor. This is based on the 10% Employability Skills.

1.5 At 10% of accumulated hours of unexcused absence you will be asked to a scheduled meeting with your Professor and will be asked to sign a contract enabling you to continue the course.

1.6 If you are absent from class, the lesson material is your responsibility.

## 2. BEHAVIOR/ATTITUDE

2.1 Students are required to:

a) Properly care for and maintain all shop and classroom equipment.
b) Properly clean the shop/classroom facility and equipment at the end of each class.
c) Remain in the class during clean-up and assist in the cleaning and shutting down of their shop/classroom.

2.2 Students are expected to conduct themselves in a manner that does not interfere with or obstruct the overall learning environment.

2.3 The following activities are not allowed in the shop/classrooms:

a) Horseplay.
b) Making unnecessary noise.
c) Swearing.
d) Abusive behavior.
e) Smoking, chewing smokeless tobacco, beverages and eating.

## 3. ASSIGNMENTS AND THEORY TESTS

3.1 Students are required to hand in assignments or write theory tests on the day and at the time specified/scheduled. See item #16 in the aforementioned document. You must attend 90% of the classes in a unit to be eligible to write the unit test.

3.2 Assignments will be graded as follows:

a) One day after the original due date – 70% maximum.
b) Two or more days after the original due date – 50% maximum.

**NOTE:** The only exception of guideline 3 shall be those arising from personal emergencies (i.e. car accident, family death, serious illness, employment reasons) and the student supplies a written statement to that effect. See item #16 in the aforementioned document.

4. **SAFETY**

4.1 Students are required to wear their personal protective equipment (i.e. C.S.A approved safety boots and impact safety glasses) at all times while in the shop area. See attached addendum at the end of this document.

4.2 Students must not enter the shop area or commence work before their scheduled time.

4.3 Students must not work alone or in an unsupervised area.

4.4 Students must have lift truck training prior to operating those units.

4.5 Students must have equipment training and Technologist/Professor approval before operating any equipment.

4.6 Students must not use or operate equipment that is found to be unsafe or damaged. All such equipment must be reported to the Professor or Technologist who will replace and/or repair the said equipment.

4.7 Where damaged or unsafe equipment cannot be repaired or replaced, the Professor/Technologist will provide students alternate shop activity.

4.8 Students must follow instructions and safe work practices in order to use or operate any shop equipment.

## VII. COURSE OUTLINE ADDENDUM:

The provisions contained in the addendum located on the portal form part of this course outline.