

**SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY**

**SAULT STE. MARIE, ONTARIO**



Sault College

**CICE COURSE OUTLINE**

**COURSE TITLE:** Heavy Equipment IV - Theory

**CODE NO. :** HED210

**SEMESTER:** Winter

**MODIFIED CODE:** HED022

**PROGRAM:** Truck and Coach / Heavy Duty Equipment Technician

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**MODIFIED BY:** Shirley Timmerman, Learning Specialist CICE Program

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**APPROVED:** "Angelique Lemay"

**TOTAL CREDITS:** \_\_\_\_\_ **CHAIR, COMMUNITY SERVICES** \_\_\_\_\_ **DATE** \_\_\_\_\_

**PREREQUISITE(S):** HED200/HED095

**HOURS/WEEK:** 8 HRS

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*School of Health and Community Services*  
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## **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 CICE student with the assistance of a Learning Specialist will demonstrate the basic ability to:

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

### Potential Elements of the Performance:

- 1 Interpret and follow hydrostatic schematic drawings.
- 2 Identify type, construction, purpose and repair procedures for hydrostatic pumps and motors, charge pumps, crossover valves and related components.
- 3 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

- 1 Distinguish between fluid couplings and torque converters.
- 2 Determine phase and stage and flow paths internally and externally of a dry sump torque converter and a wet sump converter.

### Potential Elements of the Performance Continued.....

- 1 Identify fixed, two phase and poly-phase torque converters correctly.

- 3 Identify a countershaft, and planetary power shift transmission, determine torque paths, and internal, external hydraulic flow.
  - 4 Analyze the results of a torque converter stall test.
  - 5 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:

- 1 Distinguish between drum and disc brake assemblies.
  - 2 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.
  - 3 Interpret brake system schematics as applied to air brake systems.
  - 4 Identify manual and self-adjusting adjustment mechanisms in air brake systems.
  - 5 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

- 1 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

- 1 Distinguish between engine, drive train, hydraulic and overall vehicle microprocessor management.
- 1 Identify advantages of electronic verses conventional engine fuel injection systems

- 2 Categorize electronic devices into input, output or microprocessor hardware.
  - 3 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
  - 4 Identify analog and digital sensors and actuators and their operating principles.
  - 5 Follow diagnostic procedures using various computer software and troubleshooting flow charts and service manuals.
  - 6 Interpret active fault codes and logged events.
  - 7 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:

- 1 Identify both spark ignition and compression ignition engine exhaust emission make up.
  - 2 Distinguish the effect of ignition and injection timing, engine temperature, fuel quality, load, rpm and emission devices on diesel exhaust quality.
  - 3 Identify PCV, EGR, vapour capturing devices, air / fuel ratio control devices, and exhaust conditioning devices for modern day gas and diesel engines.
  - 4 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

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

**III. TOPICS:**

1. HYDROSTATICS

- 1 Hydrostatic Transmissions
- 2 Hydrostatic Diagnostics and Troubleshooting

2. HYDRODYNAMIC DRIVES

- 1 Fluid couplings
- 2 Torque Converters
- 3 Powershift Transmissions - Countershaft, Planetary
- 4 Stall Testing and Troubleshooting

3. VEHICLE BRAKING SYSTEMS

- 1 Air

4. VEHICLE RETARDING SYSTEMS

- 1 Engine Compression Systems (Jake Brake)
- 2 Exhaust Retarders
- 3 Hydraulic Retarders
- 4 Electric Retarders

5. ELECTRONIC ENGINE MANAGEMENT

- 1 Partial Authority Systems
  - (I) PEEC
- 2 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

- o1 Air / fuel Ratio Controls
- o2 Crankcase Ventilation
- o3 Evaporative Management
- o4 Catalytic Converters
- o5 Scrubbers and Filters
- o6 Exhaust Recirculation (EGR)
- o7 Cat ACERT Technology

#### 7. AIR CONDITIONING SYSTEMS

- 1 Fundamentals of the refrigeration cycle.
- 2 Refrigerant types.
- 3 Compressor operation.
- 4 Condenser types and styles.
- 5 Expansion valves and fixed orifice systems.
- 6 Evaporator types and styles.
- 7 System design and layout.
- 8 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;

- 1 70% of semester theory examination average
- 2 20% of semester theory assignment average
- 3 10% of assessed employability skills ( attendance, punctuality, work ethics, and general attitude)

The following semester grades will be assigned to students in postsecondary courses:

<u>Grade</u>	<u>Definition</u>	<u>Grade Point Equivalent</u>
A+	90 - 100%	4.00
A	80 - 89%	3.75
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% or below	0.00
	Failure – the student has not achieved the objectives of the course and the course must be repeated.	
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field placement or non-graded subject areas.	
U	Unsatisfactory achievement in field placement or non-graded subject areas.	
X	A temporary grade. This is used in limited situations with extenuating circumstances giving a student additional time to complete the requirements for a course (see <i>Policies &amp; Procedures Manual – Deferred Grades and Make-up</i> ).	
NR	Grade not reported to Registrar's office. This is used to facilitate transcript preparation when, for extenuating circumstances, it has not been possible for the faculty member to report grades.	

## **VI. SPECIAL NOTES:**

### Disability Services:

If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your instructor and/or the Disability Services office. Visit Room E1204 or call Extension 2703 so that support services can be arranged for you.

### Retention of course outlines:

It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

### Plagiarism:

Students should refer to the definition of “academic dishonesty” in the Student Code of Conduct. Students who engage in “academic dishonesty” will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course/program, as may be decided by the professor/dean. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

### Course outline amendments:

The Professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Substitute course information is available in the Registrar's office.

## **VII. PRIOR LEARNING ASSESSMENT:**

Students who wish to apply for advance credit transfer (advanced standing) should obtain an Application for Advance Credit from the program coordinator (or the course coordinator regarding a general education transfer request) or academic assistant. Students will be required to provide an unofficial transcript and course outline related to the course in question.

Credit for prior learning will also be given upon successful completion of a challenge exam or portfolio.



## **CICE Modifications:**

### **Preparation and Participation**

1. A Learning Specialist will attend class with the student(s) to assist with inclusion in the class and to take notes.
2. Students will receive support in and outside of the classroom (i.e. tutoring, assistance with homework and assignments, preparation for exams, tests and quizzes.)
3. Study notes will be geared to test content and style which will match with modified learning outcomes.
4. Although the Learning Specialist may not attend all classes with the student(s), support will always be available. When the Learning Specialist does attend classes he/she will remain as inconspicuous as possible.

#### **A. Tests may be modified in the following ways:**

1. Tests, which require essay answers, may be modified to short answers.
2. Short answer questions may be changed to multiple choice or the question may be simplified so the answer will reflect a basic understanding.
3. Tests, which use fill in the blank format, may be modified to include a few choices for each question, or a list of choices for all questions. This will allow the student to match or use visual clues.
4. Tests in the T/F or multiple choice format may be modified by rewording or clarifying statements into layman's or simplified terms. Multiple choice questions may have a reduced number of choices.

#### **B. Tests will be written in CICE office with assistance from a Learning Specialist.**

##### ***The Learning Specialist may:***

1. Read the test question to the student.
2. Paraphrase the test question without revealing any key words or definitions.
3. Transcribe the student's verbal answer.
4. Test length may be reduced and time allowed to complete test may be increased.

#### **C. Assignments may be modified in the following ways:**

1. Assignments may be modified by reducing the amount of information required while maintaining general concepts.
2. Some assignments may be eliminated depending on the number of assignments required in the particular course.

##### ***The Learning Specialist may:***

1. Use a question/answer format instead of essay/research format
2. Propose a reduction in the number of references required for an assignment
3. Assist with groups to ensure that student comprehends his/her role within the group
4. Require an extension on due dates due to the fact that some students may require additional time to process information
5. Formally summarize articles and assigned readings to isolate main points for the student
6. Use questioning techniques and paraphrasing to assist in student comprehension of an assignment

#### **D. Evaluation:**

Is reflective of modified learning outcomes.