



## COURSE OUTLINE: MPT0234 - HD DRIVE TRAINS

Prepared: George Parsons

Approved: Martha Irwin, Chair, Community Services and Interdisciplinary Studies

<b>Course Code: Title</b>	MPT0234: HEAVY DUTY DRIVE TRAINS
<b>Program Number: Name</b>	1120: COMMUNITY INTEGRATN
<b>Department:</b>	C.I.C.E.
<b>Semesters/Terms:</b>	22W
<b>Course Description:</b>	<p>Students in the CICE Program, with the assistance of a Learning Specialist, will be introduced to the construction, operation, maintenance, and diagnosis of both highway truck and off road heavy machinery drive trains. The highway truck components will include tandem differentials, inter-axle differentials and twin countershaft transmissions. Off-road equipment drive trains will include, steering clutches and brakes, final drives, torque converters, power shift transmissions and hydrostatic drives.</p> <p>Students will be required to follow proper safety procedures when performing the above tasks according to both Sault College Motive Power Department Standards and Vehicle Manufacturers safety regulations and specifications.</p>
<b>Total Credits:</b>	3
<b>Hours/Week:</b>	6
<b>Total Hours:</b>	42
<b>Prerequisites:</b>	There are no pre-requisites for this course.
<b>Corequisites:</b>	There are no co-requisites for this course.
<b>Essential Employability Skills (EES) addressed in this course:</b>	<p>EES 1 Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.</p> <p>EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication.</p> <p>EES 3 Execute mathematical operations accurately.</p> <p>EES 4 Apply a systematic approach to solve problems.</p> <p>EES 5 Use a variety of thinking skills to anticipate and solve problems.</p> <p>EES 6 Locate, select, organize, and document information using appropriate technology and information systems.</p> <p>EES 7 Analyze, evaluate, and apply relevant information from a variety of sources.</p> <p>EES 8 Show respect for the diverse opinions, values, belief systems, and contributions of others.</p> <p>EES 9 Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals.</p> <p>EES 10 Manage the use of time and other resources to complete projects.</p> <p>EES 11 Take responsibility for ones own actions, decisions, and consequences.</p>

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2021-2022 academic year.



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<b>Course Evaluation:</b>	<p>Passing Grade: 50%, D</p> <p>A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.</p>				
<b>Other Course Evaluation &amp; Assessment Requirements:</b>	<p><b>EVALUATION PROCESS/GRADING SYSTEM:</b>  The final grade for this course will be based on the results of classroom, assignments and shop evaluations weighed as indicated:</p> <p>Classroom 30% of the final grade is comprised of term tests  Assignments 20% of the final grade is comprised of a number of technical reports  Shop 40% of the final grade is comprised of attendance, punctuality, preparedness, student ability, work organization and general attitude</p> <p>Employability Skills 10% of final grade is comprised of attendance, class participation, show ability to follow direction and being a team player.</p> <p>All Assignments must be typed.  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.</p> <p>(Student will be given notice of test and assignment dates in advance)</p> <p>The following semester grades will be assigned to students:</p> <p>Grade  Definition  A+ 90 - 100%  A 80 - 89%  B 70 - 79%  C 60 - 69%  D 50 59%  F (Fail)49% and below</p> <p>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.</p>				
<b>Books and Required Resources:</b>	<p>Heavy Duty Truck Systems by Bennett  Publisher: Cengage Learning Edition: 7th ed</p>				
<b>Course Outcomes and Learning Objectives:</b>	<p>Upon successful completion of this course, the CICE student, with the assistance of a Learning Specialist will acquire varying levels of skill development relevant to the following learning outcomes:</p> <table border="1" data-bbox="505 1350 1450 1456"> <thead> <tr> <th data-bbox="505 1350 805 1385"><b>Course Outcome 1</b></th> <th data-bbox="805 1350 1450 1385"><b>Learning Objectives for Course Outcome 1</b></th> </tr> </thead> <tbody> <tr> <td data-bbox="505 1385 805 1456">Explain the construction, operating principles, testing</td> <td data-bbox="805 1385 1450 1456"> <ul style="list-style-type: none"> <li>• static and dynamic friction</li> <li>• torque multiplication</li> </ul> </td> </tr> </tbody> </table>	<b>Course Outcome 1</b>	<b>Learning Objectives for Course Outcome 1</b>	Explain the construction, operating principles, testing	<ul style="list-style-type: none"> <li>• static and dynamic friction</li> <li>• torque multiplication</li> </ul>
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	<p>and diagnosis required to repair torque converters, fluid couplings, and hydraulic retarders.</p>	<ul style="list-style-type: none"> <li>• centrifugal force</li> <li>• vortex and rotary flow</li> <li>• kinetic energy</li> <li>• hydrodynamic drive</li> <li>• hydrostatic drive</li> <li>• multiplication phase</li> <li>• coupling phase</li> <li>• hydraulic retarders</li> <li>• pumps</li> <li>• impeller</li> <li>• stator, fixed and rotating</li> <li>• overrunning clutch</li> <li>• flywheel</li> <li>• lock-up device</li> </ul> <p>HYDRAULIC RETARDERS</p> <ul style="list-style-type: none"> <li>• rotor and housing</li> <li>• control valve</li> </ul> <p>PERFORM A DEMONSTRATION OF TORQUE CONVERTER:</p> <ul style="list-style-type: none"> <li>• stall tests</li> <li>• relief valve tests</li> <li>• performance tests</li> <li>• Oil level check</li> <li>• Oil condition</li> </ul>
	<p><b>Course Outcome 2</b></p> <p>HYDROSTATIC DRIVES Describe and define the purpose and fundamentals, types, designs and construction features and perform the inspection, testing, and diagnostic procedures following manufacturers` recommendations and perform assigned operations on hydrostatic drives.</p>	<p><b>Learning Objectives for Course Outcome 2</b></p> <p>APPLICATION:</p> <ul style="list-style-type: none"> <li>• traction drives</li> <li>• non-traction drives</li> </ul> <p>TYPES:</p> <ul style="list-style-type: none"> <li>• open loop circuits</li> <li>• closed loop circuits</li> </ul> <p>FUNDAMENTALS:</p> <ul style="list-style-type: none"> <li>• lubricant types</li> <li>• hydraulic pressures and output force</li> <li>• coolers and circuits</li> </ul> <p>PERFORM TEST PRESSURES OF HYDROSTATIC DRIVE SYSTEMS</p>
	<p><b>Course Outcome 3</b></p> <p>POWER SHIFT TRANSMISSIONS. Define the purpose and fundamentals and perform inspection, testing, and diagnostic procedures following manufacturers` recommendations and perform assigned operations</p>	<p><b>Learning Objectives for Course Outcome 3</b></p> <p>Control Systems:</p> <ul style="list-style-type: none"> <li>• hydraulic</li> <li>• pneumatic</li> <li>• electronic</li> </ul> <p>Planetary Gear Sets:</p> <ul style="list-style-type: none"> <li>• simple</li> <li>• sun gear</li> <li>• planet pinions and carrier</li> <li>• ring gear</li> </ul>

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	for power shift transmission systems.	<ul style="list-style-type: none"> <li>• compound</li> <li>• lubrication</li> <li>• Check and test fluid levels and condition.</li> <li>• Perform a demonstration of recommended procedures to perform oil and filter changes.</li> </ul>
	<b>Course Outcome 4</b>	<b>Learning Objectives for Course Outcome 4</b>
	<p>TANDEM AND INTERAXLE DIFFERENTIALS</p> <p>Define the purpose, operation and fundamentals of, and describe the functions, construction, composition, types, styles and application and perform disassembly, inspection, testing, diagnostic and reassembly procedures of multiple speed and double reduction drive axle assemblies following manufacturers` procedures.</p>	<ul style="list-style-type: none"> <li>• Mechanical advantage</li> <li>• Laws of levers</li> <li>• Torque</li> <li>• Input / output rotational speed</li> <li>• Gear ratios</li> <li>• Loading characteristics</li> <li>• Differential action</li> <li>• Thrust loads</li> <li>• Power flow</li> <li>• Bearing preloads</li> <li>• Lubrication</li> </ul> <p>Outline procedure for checking lubricant levels</p> <ul style="list-style-type: none"> <li>• Outline recommended lubricant change levels</li> <li>• Verify lubricant type and application</li> <li>• Carrier removal, disassembly, reassembly and replacement</li> <li>• procedure</li> </ul> <p>Failure analysis to identify</p> <ul style="list-style-type: none"> <li>• Shock failures</li> <li>• Fatigue failures</li> <li>• Torsional failures</li> <li>• Surface failures</li> <li>• Spinout failures</li> <li>• Operational overloading</li> <li>• Temperature effects</li> </ul> <p>Demonstrate procedure for setting</p> <ul style="list-style-type: none"> <li>• Pinion bearing preload</li> <li>• Pinion depth</li> <li>• Carrier bearing preload</li> <li>• Drive gear set backlash</li> </ul> <p>Procedure for checking</p> <ul style="list-style-type: none"> <li>• Drive gear set contact patterns</li> <li>• Drive gear set backlash</li> <li>• Thrust screw adjustment</li> </ul>
	<b>Course Outcome 5</b>	<b>Learning Objectives for Course Outcome 5</b>

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	<p><b>SERVICING TWIN COUNTERSHAFT TRANSMISSIONS</b>  Recommend reconditioning or repairs following manufacturers` procedures and perform assigned operations on multiple countershaft manual transmission and auxiliary sections.</p>	<p>Outline procedure for checking lubricant levels</p> <ul style="list-style-type: none"> <li>• Outline recommended lubricant change intervals and procedure</li> <li>• Verify lubricant types and application</li> <li>• Transmission removal, disassembly, reassembly, timing and replacement procedures</li> <li>• Auxiliary section removal, disassembly, reassembly, timing and replacement procedures</li> <li>• Air pressure adjustment</li> <li>• Pneumatic valve and cylinder replacement procedure</li> <li>• O-ring replacement</li> <li>• Air filter replacement</li> <li>• System contaminant flushing</li> </ul> <p>Perform failure analysis</p> <ul style="list-style-type: none"> <li>• Shock failures</li> <li>• Fatigue failures</li> <li>• Torsional failures</li> <li>• Surface failures</li> </ul>
	<p><b>Course Outcome 6</b></p> <p><b>FINAL DRIVES</b>  Explain the principles of operation, define the purpose and fundamentals and perform inspection, testing, and diagnostic procedures following manufacturers` recommendations and perform assigned operations of final drives.</p>	<p><b>Learning Objectives for Course Outcome 6</b></p> <p>Final drives:</p> <ul style="list-style-type: none"> <li>• bevel gear</li> <li>• spiral gear</li> <li>• helical and hypoid gear</li> <li>• planetary</li> <li>• inboard and outboard</li> <li>• inspect final drives and check for:</li> <li>• gear contact patterns</li> <li>• gear backlash</li> <li>• bearing pre-load</li> <li>• perform a demonstration of:</li> <li>• lubricating oil level checks</li> <li>• seal replacement procedures</li> <li>• mechanical face-type seal</li> <li>• bearing service</li> <li>• adjustment procedures</li> </ul>

**Evaluation Process and Grading System:**

Evaluation Type	Evaluation Weight
Employability Skills	10%
Shop	40%
Theory Assignments	20%
Theory Tests	30%

**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.)

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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.** Further modifications may be required as needed as the semester progresses based on individual student(s) abilities and must be discussed with and agreed upon by the instructor.

**B. 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.

**C. 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.

**D. 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

**E. Evaluation:**

Is reflective of modified learning outcomes.

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**NOTE:** Due to the possibility of documented medical issues, CICE students may require alternate methods of evaluation to be able to acquire and demonstrate the modified learning outcomes

**Date:** December 14, 2021

**Addendum:** Please refer to the course outline addendum on the Learning Management System for further information.

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