



## COURSE OUTLINE: TCT817 - STEER SUSP BRAKE SYS

Prepared: Sylvain Belanger

Approved: Corey Meunier, Chair, Technology and Skilled Trades

<b>Course Code: Title</b>	TCT817: STEERING, SUSPENSION AND BRAKE SYSTEMS
<b>Program Number: Name</b>	6082: T/C TECHN-LEVEL III
<b>Department:</b>	MOTIVE POWER APPRENTICESHIP
<b>Semesters/Terms:</b>	20F
<b>Course Description:</b>	Upon successful completion the apprentice is able to interpret pneumatic schematic symbols and circuits, and use schematics to troubleshoot typical vehicle problems, is able to understand the principles of operation, diagnose and repair ATC and RDS systems to manufacturers and statutory standards, is able to perform air brake troubleshooting using service literature, air brake schematics and test instruments, is able to understand the principles of operation, diagnose and repair of mechanical steering gears, truck, coach, bus and trailer frames and bodies, truck and coach coupling systems, and hydraulic vehicle alignment components.
<b>Total Credits:</b>	6
<b>Hours/Week:</b>	0
<b>Total Hours:</b>	48
<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>	EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication. EES 3 Execute mathematical operations accurately. EES 4 Apply a systematic approach to solve problems. EES 5 Use a variety of thinking skills to anticipate and solve problems. EES 6 Locate, select, organize, and document information using appropriate technology and information systems. EES 7 Analyze, evaluate, and apply relevant information from a variety of sources. EES 10 Manage the use of time and other resources to complete projects.
<b>General Education Themes:</b>	Science and Technology
<b>Course Evaluation:</b>	Passing Grade: 50%, D  A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.
<b>Other Course Evaluation &amp; Assessment Requirements:</b>	Theory testing 50% Practical application testing 50%  Grade Definition Grade Point Equivalent

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 2020-2021 academic year.



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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

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.

**Books and Required Resources:**

Heavy Duty truck systems by Sean Bennett  
 Publisher: cengage Edition: 6

**Course Outcomes and Learning Objectives:**

Course Outcome 1	Learning Objectives for Course Outcome 1
Upon successful completion, the apprentice is able to interpret pneumatic schematic symbols and circuits and use schematics to troubleshoot typical vehicle problems.	<p>Explain the purpose and fundamentals of pneumatic circuit interpretation and analysis.</p> <ul style="list-style-type: none"> <li>- fluid power</li> <li>- pneumatic schematics</li> <li>- brake theory</li> <li>- potential energy</li> </ul> <p>Identify the functions, types, and application of pneumatic circuit interpretation and analysis.</p> <ul style="list-style-type: none"> <li>- air control circuits</li> <li>- air brake circuits</li> <li>- auxiliary component circuits</li> <li>- air suspensions</li> </ul> <p>Describe interpretation and diagnostic procedures on pneumatic circuits.</p> <ul style="list-style-type: none"> <li>- interpret pneumatic schematics and symbols</li> <li>- locate critical pneumatic system components</li> <li>- perform pressure tests on pneumatic circuit components at critical junctions</li> <li>- verify the performance of pneumatic valves</li> <li>- outline procedure for checking and repairing leaks</li> <li>- outline procedure for fabricating pneumatic lines and hoses</li> </ul>
Course Outcome 2	Learning Objectives for Course Outcome 2
Upon successful completion, the apprentice is able to perform air brake troubleshooting using	<p>Explain the purpose and fundamentals of brake system troubleshooting.</p> <ul style="list-style-type: none"> <li>- foundation brakes</li> </ul>

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	<p>service literature, air brake schematics and test instruments.</p>	<ul style="list-style-type: none"> <li>- stroke length</li> <li>- automatic slack adjusters</li> <li>- outline procedure for air compressor, air dryer, air receiver, testing</li> <li>- test and adjust governors</li> <li>- test control valves for recommended operation</li> <li>- brake torque balance</li> <li>- brake timing</li> <li>- pneumatic schematics</li> <li>- statutory inspection safety criteria</li> </ul> <p>Identify the functions and application of brake system troubleshooting.</p> <ul style="list-style-type: none"> <li>- air brake systems</li> <li>- hydraulic brake systems</li> <li>- air over hydraulic brake systems</li> </ul> <p>Describe inspection, testing and diagnostic procedures on brake systems.</p> <ul style="list-style-type: none"> <li>- use an OEM brake schematic to diagnostic brake system problems</li> <li>- outline procedure for diagnosing typical brake system malfunctions</li> <li>- outline the factors required to torque balance brake performance</li> <li>- troubleshoot brake torque imbalance conditions such as wheel hop</li> <li>- verify the performance of brake system control valves</li> <li>- outline the requirements for brake system pneumatic timing</li> <li>- use gauges to verify pneumatic timing</li> <li>- outline crack pressure requirements of relay valves</li> </ul> <p>Perform reconditioning or repairs following manufacturers' procedures on brake systems.</p> <ul style="list-style-type: none"> <li>- outline procedure requires to recondition on balance a brake system to manufacturer's and statutory standards</li> <li>- outline requirements for a road test to verify vehicle-braking performance</li> </ul>
	<p><b>Course Outcome 3</b></p>	<p><b>Learning Objectives for Course Outcome 3</b></p>
	<p>Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair ABS, ATC and RDS Systems to manufacturer and statutory standards.</p>	<p>Explain the purpose and fundamentals of ABS, ATC and RDS systems</p> <ul style="list-style-type: none"> <li>- pneumatic brake system fundamentals</li> <li>- electrical fundamentals</li> <li>- computer fundamentals</li> </ul> <p>Identify the functions, construction, types, and application of ABS, ATC and RDS</p>

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systems as per manufacturers' specifications.

- anti-lock brake hardware
- electronic control modules (ECM)
- anti-lock modulator controller
- traction control module
- wheel sensors
- fail relays
- diagnostic displays
- trailer ABS systems
- tractor/trailer signaling and warnings
- accelerometers
- gyroscopic sensors

Describe the principle(s) of operation of ABS, ATC and RDS systems.

- electronic control module (ECM)
- anti-lock modulator controller
- traction control module
- wheel sensors
- fail relay
- pneumatic timing
- brake balance
- brake phasing
- valve crack pressures
- dynamic braking effect
- load transfer
- pressure protection devices
- brake system management from tractor
- multiplexing
- SAE J1939 requirements
- active suspension / brake / traction control systems
- trailer ABS
- tractor/ trailer communications
- gyroscopic sensors
- yaw evaluation

Perform inspection, testing and diagnostic procedures on ABS, ATC, and RDS systems

- overview current truck and coach ABS systems
- outline dynamic and static testing
- fault code interpretation
- electronic control module (ECM)
- anti-lock modulator controller
- traction control module
- roll and directional tracking sensors
- wheel sensors
- fail relay
- pneumatic timing
- brake balance
- brake phasing

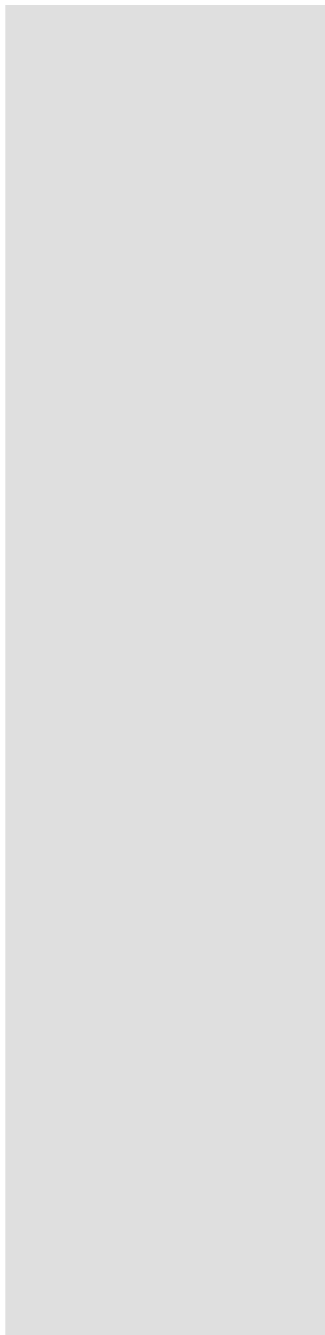
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		<ul style="list-style-type: none"> <li>- valve crack pressures</li> <li>- dynamic braking effect</li> <li>- load transfer</li> <li>- verify traction control operation</li> <li>- static discharge precautions</li> <li>- distinguish between electronic and pneumatic malfunctions</li> </ul> <p>Recommend reconditioning or repairs following manufacturers' procedures on ABS, ATC and RDS systems.</p> <ul style="list-style-type: none"> <li>- perform prescribed preventive maintenance checks</li> <li>- outline procedure for removal and replacement</li> <li>- ABS / ATC/ RSC modules</li> <li>- programming options</li> <li>- Input circuit components</li> <li>- output circuit components</li> </ul>
	<b>Course Outcome 4</b>	<b>Learning Objectives for Course Outcome 4</b>
	<p>Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair of ABS and ATC Systems.</p>	<p>Explain the purpose and fundamentals of medium and heavy-duty steer axle systems.</p> <ul style="list-style-type: none"> <li>- solid axle</li> <li>- twin beam</li> <li>- fully independent</li> <li>- caster</li> <li>- KPI</li> <li>- tow</li> <li>- vehicle tracking</li> </ul> <p>Identify the functions, construction, composition, types, styles and applications of medium and heavy duty steer axle systems.</p> <ul style="list-style-type: none"> <li>- solid and twin I beam front axles</li> <li>- steering knuckles</li> <li>- drag links</li> <li>- one piece</li> <li>- two piece</li> <li>- steering arms (Ackerman arms)</li> <li>- kingpins</li> <li>- tie rods and tie rod ends</li> <li>- pitman arms</li> <li>- fully independent</li> <li>- control arms</li> <li>- center-link</li> <li>- pitman arm</li> <li>- idler arms</li> <li>- ball joints (tension and compression)</li> <li>- steering arms (Ackerman arms)</li> <li>- knuckle (spindle)</li> <li>- tie rods (inner and outer)</li> <li>- steering control rods (rack and pinion)</li> <li>- dual steer axles</li> </ul>

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	<ul style="list-style-type: none"><li>- coil springs</li><li>- steering dampeners</li><li>- shock absorbers</li><li>- tandem axle alignment</li></ul> <p>Describe the principle(s) of operation of medium and heavy duty steer axle systems.</p> <ul style="list-style-type: none"><li>- solid axle</li><li>- twin I beam front axles</li><li>- fully independent</li><li>- dual steer axles</li><li>- steering geometry</li><li>- Ackerman principle</li><li>- caster</li><li>- camber</li><li>- steering axis inclination</li><li>- kingpin</li><li>- ball joint</li></ul> <p>Perform inspection, testing and diagnostic procedures on medium and heavy-duty steer axle systems.</p> <ul style="list-style-type: none"><li>- visual inspection of components</li><li>- wear</li><li>- loose</li><li>- damage</li><li>- defective</li><li>- outline the procedure for front axle king pin replacement.</li></ul> <p>Recommend reconditioning or repairs following manufacturers' procedures on medium and heavy-duty steer axle systems.</p> <ul style="list-style-type: none"><li>- outline maintenance and servicing of:<ul style="list-style-type: none"><li>- solid axle system components</li><li>- twin I beam system components</li><li>- independent suspension components</li><li>- coil springs</li></ul></li><li>- outline OEM wear limits</li><li>- outline safety check procedures</li></ul>
<b>Course Outcome 5</b>	<b>Learning Objectives for Course Outcome 5</b>
Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair vehicle alignment components and be able to perform adjustments to manufacturer and statutory standards.	Explain the purpose and fundamentals of medium and heavy duty vehicle alignments. <ul style="list-style-type: none"><li>- camber</li><li>- caster</li><li>- KPI</li><li>- toe-in, neutral toe and toe-out factors</li><li>- steering geometry dynamics</li><li>- steering geometry performance analysis</li><li>- tractor alignment factors</li><li>- tractor-trailer alignment factors</li></ul>

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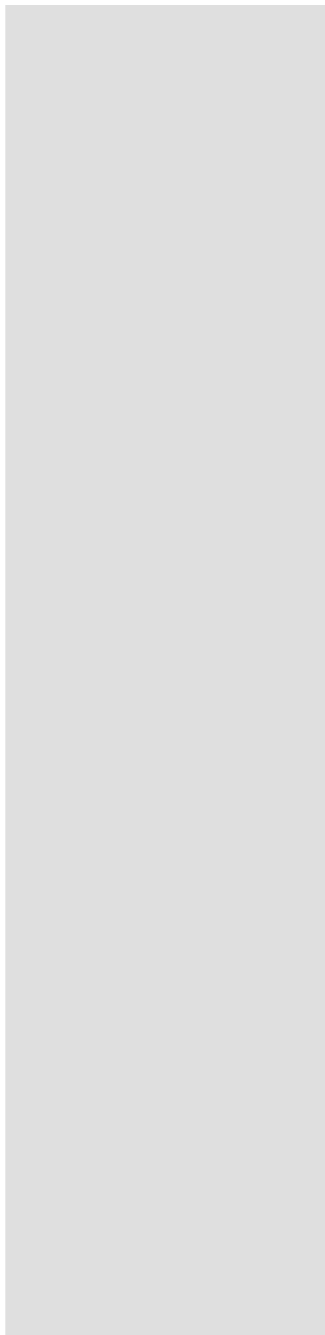
		<ul style="list-style-type: none"> <li>- coach alignment factors</li> </ul> <p>Identify the functions, types, styles and operation of medium and heavy-duty vehicle alignment equipment.</p> <ul style="list-style-type: none"> <li>- computerized alignment equipment</li> <li>- trammel gauge (bar)</li> <li>- trailer alignment</li> <li>- bazooka</li> </ul> <p>Describe inspection, testing, diagnostic and demonstrate alignment procedures.</p> <ul style="list-style-type: none"> <li>- inspection and adjust critical steering system components</li> <li>- identify steering system maladjustment</li> <li>- analyze tire wear patterns</li> <li>- test steering system wears limits to statutory requirements</li> <li>- align medium / heavy duty vehicle</li> </ul> <p>Recommend reconditioning or repairs following manufacturers' procedures on medium and heavy-duty vehicles.</p> <ul style="list-style-type: none"> <li>- describe procedures to replace defective suspension and steering components</li> <li>- outline medium duty vehicle alignment procedures</li> <li>- outline heavy-duty vehicle alignment procedures</li> <li>- outline tractor-trailer combination alignment procedures</li> <li>- outline coach alignment procedures</li> </ul>
	<b>Course Outcome 6</b>	<b>Learning Objectives for Course Outcome 6</b>
	<p>Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair mechanical steering gear.</p>	<p>Explain the history, purpose and fundamentals of mechanical steering gear.</p> <ul style="list-style-type: none"> <li>- fundamentals enhancement</li> </ul> <p>Identify the functions, construction, composition, types, styles and application of mechanical steering gear.</p> <ul style="list-style-type: none"> <li>- manual steering gear</li> <li>- twin cam and lever</li> <li>- recirculating ball</li> <li>- pneumatic assist</li> <li>- control valve</li> <li>- air cylinder</li> </ul> <p>Describe the principle(s) of operation of mechanical steering gear.</p> <ul style="list-style-type: none"> <li>- manual steering gear</li> <li>- twin cam and lever</li> <li>- recirculating ball</li> <li>- pneumatic assist</li> </ul>

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		<p>Perform inspection, testing and diagnostic procedures on mechanical steering gear.</p> <ul style="list-style-type: none"> <li>- visual checks of steering gear box operation and condition for manual and pneumatic assist assemblies.</li> <li>- demonstration of recommended steering angle checks and adjustments</li> <li>- disassemble, inspect, reassemble and adjust manual steering gear</li> </ul> <p>Recommend reconditioning or repairs following manufactures' procedures on mechanical steering gear.</p> <ul style="list-style-type: none"> <li>- identify and observe component wear points</li> <li>- adjust steering gear assemblies, linkages, steering stops and column phasing</li> <li>- dismantle, inspect and reassemble manual steering gear boxes.</li> </ul>
	<b>Course Outcome 7</b>	<b>Learning Objectives for Course Outcome 7</b>
	<p>Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair hydraulic power assist steering gear</p>	<p>Explain the history, purpose and fundamentals of hydraulic power assist steering gear.</p> <ul style="list-style-type: none"> <li>- hydraulics</li> <li>- hydraulic equations</li> </ul> <p>Identify the functions, construction, composition, types, styles and application of hydraulic power assist steering gear.</p> <ul style="list-style-type: none"> <li>- hydraulic assist</li> <li>- semi-integral</li> <li>- power cylinder</li> <li>- gear assembly</li> <li>- integral hydraulic</li> <li>- rack and pinion</li> <li>- reservoir</li> <li>- rotary control valve</li> <li>- power cylinder</li> <li>- steering gears</li> <li>- pumps and reservoirs</li> <li>- dual steering axles</li> <li>- master gear</li> <li>- slave gear</li> <li>- linkage arrangement</li> <li>- electronically managed steering system</li> </ul> <p>Describe the principle(s) of operation of hydraulic power assist steering gear.</p> <ul style="list-style-type: none"> <li>- hydraulic assist</li> <li>- power cylinder</li> </ul>

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	<ul style="list-style-type: none"><li>- rack and pinion systems</li><li>- semi-integral gear assembly</li><li>- integral hydraulic</li><li>- reservoir</li><li>- rotary control valve</li><li>- rower cylinder</li><li>- steering arms and linkages</li><li>- pumps and reservoirs</li><li>- dual steering axles</li><li>- master gear</li><li>- slave gear</li><li>- linkage arrangement</li><li>- alignment</li><li>- tracking</li><li>- electronically managed steering systems</li></ul> <p>Perform inspection, testing and diagnostic procedures on hydraulic power assist steering gear.</p> <ul style="list-style-type: none"><li>- perform steering gear assembly adjustments</li><li>- hydraulic pump pressure tests</li><li>- hydraulic pump flow rate tests</li><li>- demonstration of pump internal leakage test</li><li>- sequential troubleshooting techniques</li><li>- verify operation of non-adjustable steering gear</li></ul> <p>Recommend reconditioning or repairs following manufacturers' on hydraulic power assist steering gear.</p> <ul style="list-style-type: none"><li>- outline dual steering axle operation</li><li>- outline procedure required to replace and set up steering gear</li><li>- outline statutory standards pertaining to steering</li></ul>
<b>Course Outcome 8</b>	<b>Learning Objectives for Course Outcome 8</b>
Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair truck, coach, bus and trailer frames and bodies.	<p>Explain the purpose and fundamentals of frames and bodies.</p> <ul style="list-style-type: none"><li>- frame dynamics</li><li>- bridge formula</li><li>- basic metallurgy</li></ul> <p>Identify the functions, construction, composition, types, styles and application of frames and bodies.</p> <ul style="list-style-type: none"><li>- ladder</li><li>- unitized trailer</li><li>- monocoque / unibody coach</li><li>- combination (trailer)</li><li>- telescoping</li><li>- collision damage categories</li></ul> <p>Describe the principle(s) of operation of frames and bodies.</p>

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		<ul style="list-style-type: none"> <li>- frame characteristics</li> <li>- tensional and compressional loading</li> <li>- neutral fibre</li> <li>- section modulus</li> <li>- material strength factors / yield and tensile strength</li> <li>- frame materials</li> <li>- aluminum alloys</li> <li>- tempered aluminum</li> <li>- mild steels</li> <li>- tempered steels</li> <li>- bridge formula</li> <li>- frame oscillation</li> <li>- resist bend moment (RBM)</li> <li>- RBM calculations</li> <li>- collision damage analyses</li> <li>- attachments</li> </ul> <p>Perform inspection and testing procedures on frames and bodies.</p> <ul style="list-style-type: none"> <li>- project a frame to floor diagram</li> <li>- identify common frame misalignment factors</li> <li>- diagnose frame failure by types</li> </ul> <p>Recommend reconditioning or repairs following manufacturers' procedures on frames.</p> <ul style="list-style-type: none"> <li>- outline procedure for removing and replacing cross members</li> <li>- outline procedure for removing and replacing frame rails</li> <li>- outline frame alignment procedure</li> <li>- outline procedure for reconditioning coach unibody chassis</li> </ul>
	<b>Course Outcome 9</b>	<b>Learning Objectives for Course Outcome 9</b>
	<p>Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair of truck and coach coupling systems.</p>	<p>Explain the purpose and fundamentals of coupling devices.</p> <ul style="list-style-type: none"> <li>- articulation</li> <li>- traction / tractive vehicle dynamics</li> </ul> <p>Identify the functions, construction, composition, types, styles and applications of coupling devices.</p> <ul style="list-style-type: none"> <li>- fifth wheels</li> <li>- semi-oscillating</li> <li>- fully-oscillating</li> <li>- non-tilt convertible</li> <li>- compensating</li> <li>- rigid</li> <li>- stationary</li> <li>- sliding</li> <li>- locking devices</li> <li>- no slack</li> <li>- cast head</li> <li>- pressed head</li> </ul>

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- brackets, saddles, pins and bushings
- kingpins
- SAE ratings
- pintle hooks
- eyes
- ball hitched
- coupler plates
- fastener specifications
- safety chains
- mounting brackets
- mounting location
- trailer landing gear

Describe the principle(s) of operation and inspection of coupling devices.

- fifth wheels
- locking principles
- secondary locks
- specifications and ratings
- mounting height and location
- pintle hooks
- buffer assembly
- articulation
- eyes
- ball hitches
- kingpins
- coupler plates
- high hitch factors
- trailer landing gear

Perform inspection and testing procedures of coupling devices.

- check air controls
- for leaks
- operation
- check coupling devices for
- locking ability and security
- wear tolerances
- correct engagement
- disassemble, inspect, adjust and reassemble fifth wheel
- verification of lock engagement
- indicators of wear
- lubrication
- tongue weight
- welding integrity
- fasteners
- chains, hooks and cables
- performance test overhauled fifth wheels

Recommend reconditioning or repairs following manufacturers procedures on coupling devices.

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- removal and cleaning practices
- measuring practices
- overhaul procedures

**Evaluation Process and Grading System:**

<b>Evaluation Type</b>	<b>Evaluation Weight</b>
practical application testing	50%
theory testing	50%

**Date:**

September 2, 2020

**Addendum:**

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

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