Prepared: Sylvain Belanger Approved:

Course Code: Title	TCT713: ELECTRICAL SYSTEMS
Program Number: Name	6081: T/C TECHN LEVEL II
Department:	MOTIVE POWER APPRENTICESHIP
Semester/Term:	18S
Course Description:	Upon successful completion the apprentice is able to understand the principles of operation, diagnose and repair heavy-duty batteries, truck and heavy duty cranking circuits, and truck and coach auxiliary electrical components, is able to understand the principles of Electrical circuit schematics and use them to diagnose and repair truck and coach electrical systems, and is able to understand the fundamental of electronics and diagnose malfunctions in electronically managed circuits and components.
Total Credits:	5
Hours/Week:	0
Total Hours:	40
Essential Employability Skills (EES):	#2. Respond to written, spoken, or visual messages in a manner that ensures effective communication. #3. Execute mathematical operations accurately. #4. Apply a systematic approach to solve problems. #5. Use a variety of thinking skills to anticipate and solve problems. #6. Locate, select, organize, and document information using appropriate technology and information systems. #7. Analyze, evaluate, and apply relevant information from a variety of sources. #10. Manage the use of time and other resources to complete projects.
General Education Themes:	Science and Technology
Course Evaluation:	Passing Grade: 50%, D
Other Course Evaluation & Assessment Requirements:	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

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W Student has withdrawn from the course without academic penalty.

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
practical application testing	40%
theory testing	60%

Books and Required Resources:

Heavy Duty truck systems by Sean Bennett
Publisher: cengage

Course Outcomes and Learning Objectives:

Course Outcome 1.

Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair heavy-duty batteries.

Learning Objectives 1.

Upon successful completion, the apprentice is able to:
3.1.1 Explain the purpose and fundamentals of heavy-duty batteries.
[1/0] - internal resistance factors
- specific gravity
- state of charge
- chemical action
- temperature factors
3.1.2 Identify the functions, construction, composition, types, styles and application of heavyduty batteries.
[2/0] - maintenance free batteries
- gelled electrolyte batteries
- Heavy duty battery classifications
- Heavy duty battery cable classifications
- deep cycle batteries
- absorbed glass matt (AGM)
- gel cell
- Lithium Ion Batteries
- Nickel Metal Hydride (NmMH)
- ultra-capacitors

3.1.3 Describe the principle(s) of operation of heavy-duty batteries.
[2/0] - internal resistance ratings
- cranking requirements
- analyzing battery performance
- series and series-parallel battery banks
- inverters
- deep cycle batteries

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TRUCK & COACH TECHNICIAN - LEVEL 2
- absorbed glass matt (AGM)
- gel cell
- Lithium Ion (LiOn)Batteries
- Nickel Metal Hydride (NmMH)
- ultracapacitors

3.1.4 Perform inspection, testing and diagnostic procedures on heavy-duty batteries.
[0/2] - visual inspection
- state of charge
- surface discharge
- load test
- high rate discharge
- temperature adjustments
- hydrometer / refractometer test
- capacitance testing
- electrochemical impedance spectroscopy (EIS) testing

3.1.5 Recommend reconditioning or repairs following manufacturersÃ¢â`¬â ¢ procedures on heavyduty batteries.
[0/1] - maintenance
- state of charge
- storage
- activation
- charging procedures
- cleaning precautions
- boost and boost generator charge precautions

Course Outcome 2.

Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair heavy duty cranking circuits

Learning Objectives 2.

Upon successful completion, the apprentice is able to:
3.2.1 Explain the purpose and fundamentals of a heavy duty cranking circuit.
[1/0] - permanent magnets
- electromagnetism
- Ohm`s law
- Watt`s law
- torque and wattage
- counter-electromotive force (CEMF)
- centrifugal force
- voltage drop
- batteries

3.2.2 Identify the functions, construction, and application of a heavy duty cranking circuit.
[2/0] - cranking motors
- hybrid start systems
- series
- series-shunt
- series-parallel
- field windings

- armature
- commutator
- brushes
- springs
- permanent magnet
- gear reduction
- relays
- solenoids
- drives
- series-parallel switching
- electromechanical & electronic cranking controls

3.2.3 Describe the principle(s) of operation of heavy duty cranking circuit.
[3/0] - electromagnetic principles
- electric motor principle
- cranking motors
- series
- series-shunt
- series-parallel
- CEMF effect on current flow
- temperature effect on load and torque output
- high current demands
- relays
- solenoids
- drives
- overrunning clutch
- disengagement protection
- over-crank protection
- automatic lockout and disengagement

3.2.4 Perform inspection, testing and diagnostic procedures on heavy duty cranking circuit components.
[0/3] - outline cranking circuit diagnostic sequence
- perform voltage drop testing
- cranking no-load bench tests
- test relays and solenoids
- solenoid pull-in & hold-in test
- electronic cranking circuit analysis

3.2.5 Recommend reconditioning or repairs following manufacturers procedures on heavy duty cranking circuits.
[0/1] - disassemble and reassemble cranking motors
- perform component failure analysis
- outline removal and replacement of:
- relays
-solenoids
-cranking motors

Course Outcome 3.

Upon successful completion, the apprentice is able to understand the principles of Electrical circuit schematics and use them to diagnose and repair truck and coach electrical systems.

Learning Objectives 3.

Upon successful completion, the apprentice is able to:
3.3.1 Explain the purpose and fundamentals of heavy-duty electrical circuit schematics.
[0.5/0] - electricity
- electronics
- series circuits
- parallel circuits
- series parallel circuits
- electrical schematics
- schematic symbols
- icons

3.3.2 Identify the functions, types, styles and application of heavy-duty electrical circuit schematics.
[0.5/0] - OEM electrical schematics
- digital schematics
- interactive schematics

3.3.3 Describe how to interpret heavy-duty electrical circuit schematics.
[1/0] - symbols
- valley forge
- Deutsche International (DIN)/ISO

3.3.4 Perform inspection, testing and diagnostic procedures on heavy duty electrical systems using circuit schematics.
[0/3] - perform circuit analysis using OEM schematics
- test operational and malfunctioning electrical circuit components

3.3.5 Recommend reconditioning or repairs following manufacturer`s procedures on heavyduty electrical circuit schematics.
[0/1] - diagnose common circuit malfunctions
- access OEM circuit schematics
- CD-ROM
- OEM data hubs
- service manuals
- aftermarket electronic information systems

Course Outcome 4.

Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair truck and coach auxiliary electrical components.

Learning Objectives 4.

Upon successful completion, the apprentice is able to:
3.4.1 Define the purpose and fundamentals of auxiliary electrical components.
[1/0] - electricity
- electronics
- interpretation of schematics
- wiring gauge numbers (American wire gauge, and SI & SAE, colours
- SAE codes & numbering
- temperature effects of current flow through conductors
- SAE wire specifications and applications
- candlepower specifications

3.4.2 Identify the functions, construction, and application of auxiliary electrical components.
[1/0] - wiring

- core & insulation
- lighting
- signal circuits
- headlamp circuits
- light circuits
- wiper circuits
- gauges and instruments
- sending unit
- auxiliary motors

3.4.3 Describe the principle(s) of operation of auxiliary electrical components.
[2/0] - wiring circuits
- sealed electronic connectors
- lighting
- signal circuits
- headlamp circuits
- light circuits
- wiper circuits
- horns
- mirror heaters
- sending unit
- auxiliary motors

3.4.4 Perform inspection, testing and diagnostic procedures on auxiliary electrical components.
[0/1] - electrical flow charts
- demonstration of wiper and warning system component tests
- identify circuit protection devices
- cycling breakers
- non-cycling breakers
- sequential troubleshooting techniques
- high impedance digital multimeter
- reader / programmers
- PCs
- circuit damage precautions
- electrostatic discharge

3.4.5 Recommend reconditioning or repairs following manufacturersÃ¢â`¬â ¢ procedures on auxiliary
electrical components.
[0/1] - remove and replace electrical accessories
- recondition auxiliary electrical components

Course Outcome 5.

Upon successful completion, the apprentice is able to understand the fundamental of electronics
and diagnose malfunctions in electronically managed circuits and components

Learning Objectives 5.

Upon successful completion, the apprentice is able to:
3.5.1 Explain the purpose and fundamentals or electronics.
[1/0] - review of circuit calculations
- Ohm`s law
- voltage drop calculation

- semiconductor materials
- waveforms
- voltage spike control
- static electricity
- electrostatic discharge
- shielding
- grounding

3.5.2 Identify the functions, construction and application of electronic devices.
[2/0] - diodes
- rectifying
- zener
- light emitting
- photo
- transistors
- PNP
- NPN
- sensors
- reluctors
- thermister
- piezoelectric
- piezoresistive
- variable resistor
- rheostat
- potentiometers
- hall effect
- optical devices
- capacitors

3.5.3 Describe the principle(s) of operation of electronic devices.
[3/0] - diodes
- forward and reverse bias
- current control
- spike suppression
- transistors
- forward and reverse bias
- PNP and NPN
- gate controls
- switching
- amplification
- capacitors
- sensors
- reluctors
- thermistor
- piezoelectric
- piezoresistive
- variable resistor
- rheostat
- potentiometers
- thermocouple
- O2 and NOx
- binary logic

3.5.4 Perform inspection and testing procedures on electronic devices.
[0/3] - diodes
- transistors
- capacitors

	- resistors - potentiometer - variable capacitance sensors - reluctors 3.5.5 Recommend reconditioning or repairs following manufacturersÃ¢â`¬â ¢ procedures for vehicle electronic devices. [0/1] - moisture protection - component identification - explosion hazards - control of electrostatic discharge - control of component damage
Date:	Tuesday, April 24, 2018
	Please refer to the course outline addendum on the Learning Management System for further information.