



# COURSE OUTLINE

## TCT714

Prepared: John Avery    Approved: Corey Meunier

<b>Course Code: Title</b>	TCT714: FUEL SYSTEMS
<b>Program Number: Name</b>	6081: T/C TECHN LEVEL II
<b>Department:</b>	MOTIVE POWER APPRENTICESHIP
<b>Semester/Term:</b>	18S
<b>Course Description:</b>	<p><b>COURSE DESCRIPTION:</b>                      This course is designed to give the Truck &amp; Coach Apprentice(s) the theoretical knowledge of the types of fuel systems that have been used on diesel engines for trucks, busses and highway tractors. Students will learn the basic constructions and operation of the newer electronic fuel systems and controls for Full Authority management systems that are currently being used on the latest generation of diesel engines including Operation of the low pressure sub-systems, the high pressure delivery systems and Electronic controls. Students will be taught how to use Electronic Scan tools to diagnose system problems, how to test system components, repair and or replace system components properly and safely according to the Manufacturer Service Manual and Specifications. This course also explores the Gasoline and Alternate Fuels and system changes that have been introduced into the On Road Truck and Coach Vehicles.</p>
<b>Total Credits:</b>	3
<b>Hours/Week:</b>	3
<b>Total Hours:</b>	24
<b>Essential Employability Skills (EES):</b>	<p>#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.                      #8. Show respect for the diverse opinions, values, belief systems, and contributions of others.                      #9. Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals.                      #10. Manage the use of time and other resources to complete projects.                      #11. Take responsibility for ones own actions, decisions, and consequences.</p>

**General Education Themes:** Science and Technology

**Course Evaluation:** Passing Grade: 50%, D

**Other Course Evaluation & Assessment Requirements:** Assignments related to theory and appropriate application skills.  
Theory Tests 50%  
Shop Practical 30%  
Assignments 20%

**Evaluation Process and Grading System:**

Evaluation Type	Evaluation Weight
assignments	20%
practical application testing	30%
theory testing	50%

**Books and Required Resources:**

medium/heavy duty truck engines, fuels and computerized management systems by Sean Bennett  
Publisher: cengage Edition: 5

**Course Outcomes and Learning Objectives:**

## Course Outcome 1.

Upon successful completion the apprentice is able to understand the principles of high pressure diesel fuel injection, is able to understand the principle of operation, diagnose and repair Electronic Unit Injector (EUI) diesel fuel systems, and gasoline and alternate fuel injection systems, and is able to understand the principles of diesel engine governing.

## Learning Objectives 1.

### LEARNING OUTCOMES AND CONTENT

Upon successful completion, the apprentice is able to:

4.1.1 Explain the purpose and fundamentals of high pressure diesel fuel injection.

[1/0] - hydraulics  
- pressure and sectional area  
- fuel chemistry  
- requirements for combustion of liquid fuels  
- combustion characteristics  
- direct injection  
- emissions

4.1.2 Identify the functions and application of high pressure diesel fuel injection systems.

[1/0] - fuel management systems  
- fuel pressurization  
- hydraulic and mechanical pumps  
- combustion chambers  
- products of combustion  
- harmful emissions  
- carbon footprint  
- relationship between cylinder pressure and crank angle mechanics

4.1.3 Describe the principle(s) of operation and objectives of high pressure diesel fuel injection.

- [2/0] - pumping action
- effective stroke control
  - droplet sizing
  - injection timing
  - ignition timing
  - pressure management
  - phases of combustion
  - effects of timing on emissions
  - effects of timing on power output

#### LEARNING OUTCOMES AND CONTENT

Upon successful completion, the apprentice is able to:

4.2.1 Explain the purpose and fundamentals of electronic unit injector systems.

- [1/0] - electricity
- electronics
  - computers
  - digital electronics
  - input and output circuits
  - characteristics of cam geometry

4.2.2 Identify the functions, construction, and application of electronic unit injector systems.

- [3/0] - ECM: chassis and engine controllers
- switching apparatus
  - multiplexed ECMs
  - interface modules
  - injector driver units
  - EUI components (electronic unit injectors)
  - solenoid cartridge valves
  - tappet, plunger and barrel assemblies
  - hydraulic nozzle assemblies
  - electrohydraulic nozzles
  - distinguishing factors between different EUI systems

4.2.3 Describe the principle(s) of operation of electronic unit injector systems.

- [3/0] - injector driver units
- actuation voltage spiking
  - electronic unit injectors
  - control solenoids

- injection pumping components
- hydraulic nozzles
- electro-hydraulic nozzles
- effective stroke control
- injection pressure control
- multi pulse injection
- communication protocols
- interface protocols
- vehicle and engine controllers
- customer data programming
- proprietary data programming
- default modes
- tattletale / audit trail logging
- injector duty cycle/pulse width
- injector response time

4.2.4 Perform inspection, testing and diagnostic procedures electronic unit injector systems.

- [0/3] - customer data programming
- proprietary data programming
  - sequential troubleshooting using OEM text
  - circuit malfunctions
  - cylinder performance testing
  - snapshot test
  - proprietary data programming

4.2.5 Recommend reconditioning or repairs following manufacturers'™ procedures on electronic unit injector systems.

- [0/2] - procedure for diagnosing electronic malfunctions
- procedure for diagnosing hydro-mechanical malfunctions
  - procedure for replacing and reprogramming ECMs
  - demonstrate proprietary data download procedures
  - procedures for removing and replacing EUIs
  - program EUI flow rate to an ECM
  - program customer engine and chassis data to an ECM

#### GENERAL LEARNING OUTCOME

Upon successful completion, the apprentice is able to understand the principles of diesel engine governing.

#### LEARNING OUTCOMES AND CONTENT

Upon successful completion, the apprentice is able to:

4.3.1 Explain the purpose and fundamentals of diesel engine governing.

- [1/0] - diesel engine fundamentals
- diesel fuel system fundamentals
  - diesel fuel sub-systems
  - hydraulics
  - centrifugal force
  - pressure, force and flow area

4.3.2 Identify the functions, and application of diesel engine governing.

- [1/0] - mechanical governors electronic control module (ECM)
- governor algorithms

- hydraulic governors
- limiting speed (LS)
- variable speed (VS)
- isochronous
- throttle position sensors
- thrust collars
- fuel control mechanisms
- servos
- hydraulic media and lubrication
- mechanical governors

4.3.3 Describe the principle(s) of diesel engine governing.

- [1/0] - speed sensing
- load request and engine derate
  - limiting speed drivability
  - variable speed drivability
  - isochronous (PTO) modes
  - peak torque fuelling
  - rated speed fuelling
  - programmed engine droop
  - programmed road speed droop
  - smart cruise factors
  - idle, peak torque, rated, and high idle speeds
  - governing algorithm
  - of-balance fuelling
  - fuel maps
  - programming options

4.3.4 Perform inspection, testing, programming and diagnostic procedures on diesel engine governors.

- [0/1] - plot torque rise profile on a graph using data from an engine under load
- use an EST to program governor options such as LS or VS
  - interpret a diagnostic flow chart
  - analyze audit trails
  - outline procedure for fuel map download

#### GENERAL LEARNING OUTCOME

Upon successful completion, the apprentice is able to understand the principle of operation, diagnose and repair gasoline and alternate fuel injection systems.

#### LEARNING OUTCOMES AND CONTENT

Upon successful completion, the apprentice is able to:

4.4.1 Explain the purpose and fundamentals of gasoline and alternate fuel injection systems.

- [1/0] - engine theory
- fuel chemistry
  - gasoline

- propane
- CNG
- hydraulics
- combustion
- Otto cycle
- electronics

4.4.2 Identify the functions, construction and application of gasoline and alternate fuel injection systems.

- [1/0] - fuel tanks & reservoirs
- sending unit / pump assemblies
  - pressure regulators
  - accumulators
  - fuel rail
  - throttle bodies
  - electrically actuated injectors
  - electronic management circuit
  - oxygen sensors
  - input circuit
  - ECMs

4.4.3 Describe the principle(s) of operation off gasoline and alternate fuel injection systems.

- [2/0] - fuel system flow
- indirect injection principles
  - direct injection principles
  - open and closed loop factors
  - noxious emission control criteria

4.4.4 Perform inspection, testing and diagnostic procedure on gasoline and alternate fuel injection systems.

- [0/1] - identify system components
- use an EST to retrieve fault codes
  - performance test a engine

4.4.5 Recommend reconditioning or repairs following manufacturesâ€™ procedures on gasoline and alternate fuel injection systems.

- [0/1] - injector balance testing
- remove and install injectors
  - check injection circuit for flow restrictions
  - outline safe methods of locating explosive gas leakage

**Date:**

Tuesday, April 24, 2018

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