Assessment Requirements

Unit LV07K – Knowledge of Diagnosis and Rectification of Light Vehicle Engine Faults

Content:

Single and Multi-Point Petrol Injection Systems
a. The operation and construction of single and multi-point injection systems including:
   i. types of air flow sensor
   ii. fuel supply system
   iii. fuel pump
   iv. filter
   v. fuel regulator
   vi. injectors
   vii. sequential injection
   viii. continuous injection
   ix. semi-continuous injection
   x. electronic control unit (ECU)
   xi. injector pulse width
   xii. sensors
b. The operation of each system under various operating conditions including:
   i. cold starting
   ii. warm up
   iii. hot starting
   iv. acceleration
   v. deceleration
   vi. cruising
   vii. full load
c. Engine speed limiting and knock sensing.

Engine Management
a. The function and purpose of engine management systems.
b. The difference between analogue, digital, programmable and non-programmable systems.
c. Open loop and closed loop control, types of input and output devices.
d. The function and operation of digital components and systems.
e. The operation of engine management systems under various conditions.

Valve Mechanisms
a. The reasons for variable valve timing and multi-valve arrangements and the effect on performance.
b. Layout of multi-valve arrangements, components, operation and drive arrangements.
c. Construction features and operation of variable valve timing engines and electronic control.

Pressure Charged Induction Systems
a. The meaning of volumetric efficiency; explain the effect of volumetric efficiency on engine performance, torque and power.
b. The methods used to improve volumetric efficiency:
   i. variable valve timing
   ii. turbo-charging
   iii. supercharging
   iv. intercoolers
c. The operation of turbo-chargers and the purpose of:
   i. turbo-charging
ii. supercharging
iii. intercoolers
iv. waste gates
v. exhaust gas recirculation
d. Advantages and disadvantages of pressure charging induction systems.

**Terms Associated with Combustion**

a. Flame travel, pre-ignition and detonation.
b. Fuel properties:
   i. octane rating
   ii. flash point
   iii. fire point
   iv. volatility
   v. composition of petrol and diesel fuels
   vi. hydro-carbon content
c. Composition of carbon fuels (petrol and diesel):
   i. % hydrogen and carbon
   ii. composition of air
   iii. % oxygen
   iv. % nitrogen
d. Combustion process for spark ignition and compression ignition engines:
   i. air fuel ratio
   ii. lambda ratio
   iii. stoichiometric ratio
e. The by-products of combustion for different engine conditions and fuel mixtures:
   i. CO
   ii. CO₂
   iii. O
   iv. N
   v. H₂O
   vi. NOx
f. Describe the legal requirements for exhaust emissions;
   i. MOT requirements
   ii. EURO 3
   iii. 4 & 5 regulations

**Assessment, Repair and Restoration of Mechanical Engine Components**

a. How engine mechanical components are assessed and measured for wear and serviceability:
   i. cylinder bores
   ii. cylinder heads
   iii. crankshaft journals
   iv. valve faces
   v. valve guides
   vi. valve seats
   vii. camshafts
b. The methods used for the repair and restoration of engine components.

**Cooling, Heating and Ventilation**

a. The components, operating principles, and functions of engine cooling systems
b. Procedures used to remove, replace and adjust cooling system components
   i. cooling fans and control devices
   ii. header tanks, radiators and pressure caps
   iii. heater matrix’s and temperature control systems
   iv. expansion tanks hoses, clips and pipes
   v. thermostats impellers and coolant
vi. ventilation systems

c. The preparation and method of use of appropriate specialist equipment used to evaluate system
   performance following component replacement
   i. system pressure testers
   ii. pressure cap testers
   iii. hydrometer, or anti-freeze testing equipment
   iv. chemical tests for the detection of combustion gas

d. The layout and construction of internal heater systems.
e. The controls and connections within internal heater system.
f. Symptoms and faults associated with cooling systems:
   i. water leaks
   ii. water in oil
   iii. internal heating system: efficiency, operation, leaks, controls, air filtration, air leaks and
       contamination
   iv. excessively low or high coolant temperature

g. The procedures used when inspecting
   i. internal heating system
   ii. cooling system

**Air Conditioning Systems**
a. The operation of air conditioning components including:
   i. compressors
   ii. condensers
   iii. receivers
   iv. dryers
   v. connections
   vi. valves
   vii. hoses
   viii. thermostats
   ix. refrigerants

b. The layout and operation of air conditioning systems.

**Climate Control Systems**
a. Identify components used in climate control systems including:
   i. sensors
   ii. speed controls
   iii. control systems
   iv. servomotors
   v. electronic components

b. The layout of climate control systems.
c. The operation of climate control system.

**Symptoms and Faults in Engine Mechanical Systems and Components**
a. Symptoms and faults related to:
   i. worn cylinders
   ii. cylinder liners
   iii. pistons
   iv. piston rings
   v. crankshaft
   vi. camshaft
   vii. bearings
   viii. cylinder head and gasket
   ix. valves
   x. valve seats and valve guides
xi. cambelts
xii. lubrication system and components
xiii. oil pump
xiv. relief valve
xv. filter
xvi. turbo-charger
xvii. supercharger

Diagnosis of Faults in Engine Mechanical Systems and Components
a. Interpret information for:
   i. diagnostic tests
   ii. manufacturer’s vehicle and equipment specifications
   iii. use of equipment
   iv. testing procedures
   v. test plans
   vi. legal requirements
b. The preparation of tools and equipment for use in diagnostic testing and assessment.
c. Systematic assessment, testing and inspection of engine components and systems including:
   i. mechanical system & component condition
   ii. engine balance
   iii. power balance
   iv. performance and operation
   v. wear
   vi. run out
   vii. alignment
d. Use of appropriate tools and equipment including:
   i. compression gauges
   ii. leakage testers
   iii. cylinder balance tester
   iv. pressure gauges
   v. micrometers
   vi. vernier gauges
e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result and values with vehicle manufacturer’s specifications and settings.
g. The procedures for dismantling, components and systems and the use of appropriate equipment and procedures.
h. Assess, examine and measure components including:
   i. settings
   ii. values
   iii. condition
   iv. wear and performance of components and systems
i. Probable faults
   i. malfunctions
   ii. incorrect settings
   iii. wear
j. Rectification or replacement procedures.
   Evaluate operation of components and systems following diagnosis and repair to confirm system performance.

Faults and Symptoms in Ignition Systems
a. Ignition system failure or malfunctions including:
   i. no spark
   ii. misfiring
   iii. backfiring
   iv. cold or hot starting problems
v. poor performance
vi. pre-ignition
vii. detonation
viii. exhaust emission levels
ix. fuel consumption
x. low power
xi. unstable idle speed

Faults and Symptoms in Electronic Petrol and Diesel Injection Systems
a. Petrol and diesel injection system failures or malfunctions including:
   i. cold or hot starting problems
   ii. poor performance
   iii. exhaust emissions
   iv. high fuel consumption
   v. erratic running
   vi. low power
   vii. unstable idle speed

Faults and Symptoms in Engine Management Systems
a. Engine management system failure or malfunctions including:
   i. misfiring
   ii. backfiring
   iii. cold or hot starting problems
   iv. poor performance
   v. pre-ignition
   vi. detonation
   vii. exhaust emission levels
   viii. fuel consumption
   ix. low power
   x. unstable idle speed

Diagnosis of Faults in Electronic Ignition, Petrol and Diesel Injection and Engine Management Systems
a. Locate and interpret information for:
   i. diagnostic tests
   ii. manufacturer’s vehicle and equipment specifications
   iii. use of equipment
   iv. testing procedures
   v. test plans
   vi. fault codes
   vii. legal requirements
b. The preparation of tools and equipment for use in diagnostic testing and assessment.
c. Conduct systematic assessment, testing of engine systems including:
   i. component condition and performance
   ii. component settings
   iii. component values
   iv. electrical and electronic values
   v. system performance and operation
   vi. use of appropriate tools and equipment including gauges
   vii. multi-meter
   viii. breakout box
   ix. oscilloscope
   x. diagnostic tester
   xi. manufacturer’s dedicated equipment
   xii. exhaust gas analyser
xiii. fuel flow meter
xiv. pressure gauges
d. Evaluate and interpret test results from diagnostic testing.
e. Compare test result, values and fault codes with vehicle manufacturer’s specifications and settings.
f. The procedures for dismantling, components and systems using appropriate equipment.
g. Assess, examine and measure components including:
   i. settings
   ii. input and output values
   iii. voltages
   iv. current consumption
   v. resistance
   vi. output patterns with oscilloscope
   vii. condition
   viii. wear and performance of components and systems
h. Identify probable faults and indications of:
   i. faults
   ii. malfunctions
   iii. incorrect settings
   iv. wear
   v. values
   vi. inputs and outputs
   vii. fault codes
i. Rectification or replacement procedures.
j. Evaluation and the operation of components and systems following diagnosis and repair to confirm system performance.

Faults and Symptoms in Vehicle Comfort Systems
a. System failure, malfunction or ineffectiveness of internal heating system, air conditioning system or climatic control system including:
   i. leaks
   ii. abnormal noise
   iii. ineffective operation
   iv. failure to operate
   v. control faults
   vi. inadequate operation

Diagnosis of Faults in Vehicle Comfort Systems
a. Locate and interpret information for:
   i. diagnostic tests
   ii. manufacturer’s vehicle and equipment specifications
   iii. use of equipment
   iv. testing procedures
   v. test plans
   vi. fault codes
   vii. legal requirements
b. The preparation of tools and equipment for use in diagnostic testing and assessment.
c. Conduct systematic assessment and testing of comfort systems including:
   i. component condition and performance
   ii. component settings
   iii. component values
   iv. electrical and electronic values
   v. system performance and operation
   vi. drive belts
   vii. controls
   viii. compressors
   ix. condensers
x. receivers
xi. dryers
xii. connections
xiii. valve
xiv. hoses
xv. thermostats and refrigerants
xvi. sensors
xvii. speed controls
xviii. control systems
xix. servomotors
d. Use of appropriate tools and equipment including:
i. pressure gauges
ii. multi-meter
iii. breakout box
iv. oscilloscope
v. diagnostic tester
vi. manufacturer’s dedicated equipment
vii. flow meter
e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result, values and fault codes with vehicle manufacturer’s specifications and settings
g. How to dismantle, components and systems using appropriate equipment and procedures
h. How to assess, examine and measure components including: settings, input and output values, voltages, current consumption, resistance, output patterns with oscilloscope, pressures, condition, wear and performance of components and systems
i. Identification of probable faults and indications of faults, malfunctions, incorrect settings, wear, values, inputs and outputs, fault codes, pressures and leaks
j. Rectification or replacement procedures
k. Evaluation and operation of components and systems following diagnosis and repair to confirm system performance