Maintenance & Repair - Light Vehicle
(Syllabus content)

Assessment Requirements

Unit G01/02K – Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment

Content:

Economic use of Resources

a. consumable materials e.g. grease, oils, split pins, locking and fastening devices etc.

Requirement to maintain work area effectively

a. cleaning tools and equipment to maximise workplace efficiency.
b. requirement to carry out the housekeeping activities safely and in a way that minimises inconvenience to customers and staff.
c. risks involved when using solvents and detergents.
d. advantages of good housekeeping.

Spillages, leaks and waste materials

a. relevance of safe systems of work to the storage and disposal of waste materials.
b. requirement to store and dispose of waste, used materials and debris correctly.
c. safe disposal of special / hazardous waste materials.
d. advantages of recycling waste materials.
e. dealing with spillages and leaks

Basic legislative requirements

a. Provision and Use of Work Equipment Regulations 1992.
b. Power Presses Regulations 1992.
c. Pressure Systems and Transportable Gas Containers Regulations 1989.
d. Electricity at Work Regulations 1989.
e. Noise at Work Regulations 1989.
f. Manual Handling Operations Regulations 1992.
g. Health and Safety (Display Screen Equipment) Regulations 1992.
h. Abrasive Wheel Regulations.
i. Safe Working Loads.
j. Working at Height Regulations (date)

Routine maintenance of the workplace

a. Trainees personal responsibilities and limits of their authority with regard to work equipment.
b. Risk assessment of the workplace activities and work equipment.
c. Workplace person responsible for training and maintenance of workplace equipment.
d. When and why safety equipment must be used.
e. Location of safety equipment.
f. Particular hazards associated with their work area and equipment.
g. Prohibited areas.
h. Plant and machinery that trainees must **not** use or operate.
i. Why and how faults on unsafe equipment should be reported.
j. Storing tools, equipment and products safely and appropriately.
k. Using the correct PPE.
l. Following manufacturers' recommendations.

m. Location of routine maintenance information e.g. electrical safety check log.

Legislation relevant to Health and Safety

i. HASAWA
ii. COSHH
iii. EPA
iv. Manual Handling Operations Regulations 1992
v. PPE Regulations 1992

General regulations to include an awareness of:

i. Health and Safety (Display Screen Equipment) Regulations 1992
ii. Health and Safety (First Aid) Regulations 1981
iii. Health and Safety (Safety Signs and Signals) Regulations 1996
iv. Health and Safety (Consultation with Employees) Regulations 1996
v. Employers Liability (Compulsory Insurance) Act 1969 and Regulations 1998
vi. Confined Spaces Regulations 1997
vii. Noise at Work Regulations 1989
viii. Electricity at Work Regulations 1989
ix. Electricity (Safety) Regulations 1994
x. Fire Precautions Act 1971
xi. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985
xii. Pressure Systems Safety Regulations 2000
xiii. Waste Management 1991
xiv. Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002
xv. Control of Asbestos at Work Regulations 2002

Legislative duties

a. The purpose of a Health and Safety Policy.
b. The relevance of the Health and Safety Executive.
c. The relevance of an initial induction to Health and Safety requirements at your workplace.
d. General employee responsibilities under the HASAWA and the consequences of non-compliance.
e. General employer responsibilities under the HASAWA and the consequences of non-compliance.
f. The limits of authority with regard to Health and Safety within a personal job role.
g. Workplace procedure to be followed to report Health and Safety matters.

Precautions to be taken when working with vehicles, workshop materials, tools and equipment including electrical safety, pneumatics and hydraulics

a. Accessing and interpreting safety information
b. Seeking advice when needed
c. Seeking assistance when required
d. Reporting of unsafe equipment
e. Storing tools, equipment and products safely and appropriately
f. Using the correct PPE
g. Following manufacturers recommendations
h. Following application procedures e.g. hazardous substances
i. The correct selection and use of extraction equipment

PPE to include:

a. Typical maintenance procedures for PPE equipment to include:

i. typical maintenance log
ii. cleaning procedures
iii. filter maintenance
iv. variation in glove types

v. air quality checks

b Choice and fitting procedures for masks and air breathing equipment.

c. Typical workplace processes which would require the use of PPE to include:

i. welding
ii. sanding and grinding
iii. filling
iv. panel removal and replacement
v. drilling
vi. cutting
vii. chiselling
viii. removal of broken glass
ix. removal of rubber seals from fire damaged vehicles
x. removal of hypodermic needles
xi. servicing activities
xii. roadside recovery

d. Unserviceable PPE.

e. PPE required for a range automotive repair activities. To include appropriate protection of:

i. eyes
ii. ears
iii. head
iv. skin
v. feet
vi. hands
vii. lungs

Fire and extinguishers

a. Classification of fire types
b. Using a fire extinguisher effectively.

Types of Extinguishers

a. foam
b. dry powder
c. CO2
d. water
e. fire blanket

Action to be taken in the event of a fire to include:

a. The procedure as:

i. raise the alarm
ii. fight fire only if appropriate
iii. evacuate building
iv. call for assistance

Product warning labels to include:

a. Reasons for placing warning labels on containers.
b. Warning labels in common use, to include:

i. toxic
ii. corrosive
iii. poisonous
iv. harmful
v. irritant
vi. flammable
vii. explosive

Warning signs and notices

a. Colours used for warning signs:

i. red
ii. blue
iii. green

b Shapes and meaning of warning signs:
i. round
ii. triangular
iii. square

c. The meaning of prohibitive warning signs in common use.
d. The meaning of mandatory warning signs in common use.
e. The meaning of warning notices in common use.
f. General design of safe place warning signs.

Hazards and risks to include:

a. The difference between a risk and a hazard.
b. Potential risks resulting from:
i. the use and maintenance of machinery or equipment
ii. the use of materials or substances
iii. accidental breakages and spillages
iv. unsafe behaviour
v. working practices that do not conform to laid down policies
vi. environmental factors
vii. personal presentation
viii. unauthorised personal, customers, contractors etc entering your work premises
ix. working by the roadside
x. vehicle recovery
c. The employee's responsibilities in identifying and reporting risks within their working environment.
d. The method of reporting risks that are outside your limits of authority.
e. Potential causes of:

i. fire
ii. explosion
iii. noise
iv. harmful fumes
v. slips
vi. trips
vii falling objects
viii accidents whilst dealing with broken down vehicles

Personal responsibilities

a. The purpose of workplace policies and procedures on:
i. the use of safe working methods and equipment
ii. the safe use of hazardous substances
iii. smoking, eating , drinking and drugs
iv. emergency procedures
v. personal appearance
b. The importance of personal appearance in the control of health and safety.

Action to be taken in the event of colleagues suffering accidents

a. The typical sequence of events following the discovery of an accident such as:
i. make the area safe
ii. remove hazards if appropriate i.e. switch off power
iii. administer minor first aid
iv. take appropriate action to re-assure the injured party
v. raise the alarm

vi. get help
vii. report on the accident

b Typical examples of first aid which can be administered by persons at the scene of an accident:

i. check for consciousness
ii. stem bleeding
iii. keep the injured person's airways free
iv. place in the recovery position if injured person is unconscious
v. issue plasters for minor cuts
vi. action to prevent shock i.e. keep the injured party warm
vii. administer water for minor burns or chemical injuries
viii. wash eyes with water to remove dust or ingress of chemicals (battery acid)
ix. need to seek professional help for serious injuries

c Examples of bad practice which may result in further injury such as:

i. moving the injured party
ii. removing foreign objects from wounds or eyes
iii. inducing vomiting
iv straightening deformed limbs

Assessment Requirements

Unit G3K – Knowledge of Support for Job Roles in the Automotive Environment

Content:

The structure of a typical vehicle repair business

a. How these areas relate to each other within the business

i. body shop
ii. vehicle repair workshop
iii. paint shop
iv. valeting
v. vehicle parts store
vi. main office
vii. vehicle sales
viii reception

b. Sources of information

a. other staff
b. manuals
c. parts lists
d. computer software and the internet
e. manufacturer
f. diagnostic equipment

Communication requirements when carrying out vehicle repairs

a. Locating and using correct documentation and information for:

i. recording vehicle maintenance and repairs
ii. vehicle specifications
iii. component specifications
iv. oil and fluid specifications
v. equipment and tools
vi. identification codes

b. Procedures for:

i. referral of problems
ii. reporting delays
iii. additional work identified during repair or maintenance
iv. keeping others informed of progress

Methods of Communication

a. verbal
b. signs and notices

c. memos
d. telephone
e. electronic mail
f. vehicle job card
g. notice boards
h. SMS text messaging
i. Letters

a. Organisational & Customer requirements:

i. importance of time scales to customer and organization
ii. relationship between time and costs
iii. meaning of profit

b. Choice of Communication

a. distance
b. location
c. job responsibility

b. Importance of maintaining positive working relationships:
a. morale
b. productivity
c. company image
d. customer relationships
e. colleagues

Assessment Requirements

Unit G4K – Knowledge of Materials, Fabrication, Tools and Measuring Devices used in the Automotive Environment

Content:

Common types of hand tools used for fabricating and fitting in the automotive workplace. To include:

a. files
b. hacksaws and snips
c. hammers
d. screwdrivers
e. pliers
f. spanners
g. sockets
h. punches
i. types of drill and drill bits
j. taps and dies
k. stud removers
l. marking out tools

Common measuring devices used for fabrication and fitting in the automotive workplace. To include:

a. rule/tape
b. callipers
c. feeler gauge
d. volume measures
e. micrometer
f. dial gauges
g. torque wrenches
h. depth gauges

Common electrical measuring tools used in the repair of vehicles and components. To include:

a. ammeter
b. voltmeter
c. ohmmeter
d. multi-meter

Common electrical terms when measuring:

a. voltage
b. current
c. resistance

Workshop equipment (including appropriate PPE). To include:

a. hydraulic jacks
b. axle stands
c. pillar drills
d. air tools
e. vehicle lifts
f. cranes

g. hoists
h. electrical power tools

Properties, application and limitations (to include safe use) of ferrous and non-ferrous metals used when constructing, modifying and repairing vehicles and components. Materials to include:

a. carbon steels
b. alloy steels
c. cast iron
d. aluminium alloys
e. brass
f. copper
g. lead

Properties, application and limitations (to include safe use) of non-metallic materials used when constructing, modifying and repairing vehicles and components. Materials to include:

a. glass
b. plastics (inc. GRP)
c. Kevlar
d. rubber

Terms relating to the properties of materials. To include:

a. hardness
b. toughness
c. ductility
d. elasticity
e. tenacity
f. malleability
g. plasticity

Assessment Requirements

Unit G6K – Knowledge of how to Make Learning Possible through Demonstrations and Instruction

Content:

Separate areas of demonstration which encourage learning. To include:

a. demonstration is particularly applicable to learning manual skills.
b. learning to do something usually involves:
    i. purpose – the aim or objective
    ii. procedure - the most effective way of completing the task
    iii. practice – all skills require practice to improve
c. practical tasks are more quickly learnt through demonstration.
d. emphasis is required to body movements when demonstrating.
e. the demonstrator should encourage learners to ask questions.
f. emphasis should be placed upon key points whilst demonstrating.
g. any demonstration should ensure that all safety aspects are covered.

Types of learning which are best achieved and supported through demonstrations. **To include:**

a. types of learning:
    i. psychomotor – measurement of manual skill performance
    ii. cognitive – learning involving thought processes
    iii. affective – demonstration of feelings, emotions or attitudes
b. demonstration - involves learning to do something (Psychomotor Domain).
c. combination of instruction and practical demonstrations are very effective means of learning practical skills.

How to structure demonstration and instruction sessions. To include:

a. Before the demonstration and/or instruction ensure that the following good practice is recognised:
    i. identify key points
    ii. relate theoretical underpinning knowledge to key points
    iii. rehearse to ensure that all equipment is working
    iv. ensure all students can see even small equipment and processes
    v. time the demonstration
    vi. consider how to make students participate
    vii. consider how to emphasise safe working practices
b. During the demonstration and/or instruction good practice is to:
    i. give a clear introduction
    ii. identify any tools/equipment
    iii. determine the current audience level of knowledge
    iv. complete the demonstration correctly (do not show how not to do it)
    v. stress key points and show links between them
    vi. monitor safety aspects
    vii. check learner understanding
c. After the demonstration(if possible)
    i. enable the audience to practice the techniques
    ii. provide feedback on their performance

How to identify individual learning needs

a. Diagnose the learning needs of your audience to include:

i. what competencies they already have
ii. what experience they have of the subject area
iii. what competencies they need to achieve
iv. what demonstration techniques are best suited to their needs
v. how you will assess their needs have been met

What factors are likely to prevent learning. To include:

i. language barriers
ii. physical barriers
iii. specialist knowledge
iv. pace of learning
v. method of delivery
vi. environmental factors
vii. teaching styles
viii. dyslexia

How to check learners understanding and progress

a. Questionnaires.
b. Verbal questioning.
c. Observation.
d. Assessment.
e. Role play.
f. Projects/assignments.
g. Multi-choice questions.
h. Simulation.
i. Tests.

How to organise information and prepare materials

a. Identify the course aim.
b. Identify the subject aim.
c. Identify the lesson aim.
d. Complete a lesson plan - plan the teaching.
e. Identify a series of 'cues' to be used during the lesson.
f. Logically organise the information.
g. Use suitable resources and equipment to maximise learning opportunities.
h. Assess the learners progress and understanding.

Instructional techniques

a. types of instructional techniques to include:
   i. lectures
   ii. handouts
   iii. team teaching
   iv. peer teaching
   v. discussion – individual, group and peer
   vi. question and answer
   vii. multimedia
   viii. seminars
   ix. case studies
   x. project/assignments

Environmental factors that effect learning

a. environmental factors that should be considered before demonstration/instruction to include:
   i. loud noises
   ii. bright colours
   iii. bright lights

iv. strong smells
v. atmosphere
vi. temperature
vii. classroom seating
viii. classroom layout
ix. bright lights

Health and safety factors that affect learning

a. health and safety factors that should be considered before demonstration/instruction to include:
   i. assessment of risk and hazards
   ii. condition of electrical/electronic equipment
   iii. position of cables and wires
   iv. safety of equipment used in demonstration/instruction
   v. condition of classroom equipment/furniture/structure
   vi. suitable protective clothing/equipment

Analysis of demonstration/instruction

a. Analysis of demonstration/instruction to include:
   i. feedback from students
   ii. feedback from colleagues
   iii. organisational quality assessment
   iv. feedback from external organisations
   v. awarding body requirements

Developments in learning. To include:

i. multimedia based materials
ii. web based materials
iii interactive materials

How to choose and prepare appropriate materials. To include:

a. putting information in order
b. deciding whether the language used is appropriate
c. type of material i.e. paper and technology based etc.

Assessment Requirements

Unit G8K – Knowledge of how to Identify and Agree Customer Service Needs

Content:

Organisational Requirements

a. Explain the organisation's terms and conditions applicable to the acceptance of customer vehicles.
b. Explain the content and limitations of vehicle and component warranties for the vehicles dealt with by your organisation.
c. Detail what, if any, limits there are to the authority for accepting vehicles.
d. Detail why it is important to keep customers advised of progress and how this is achieved within the organisation.
e. Detail the organisation's procedures for the completion and processing of documentation and records, including payment methods and obtaining customer signatures as applicable.

Principles of Customer Communication and Care.

a. First Impressions.
b. Listening skills – 80:20 ratio.
c. Eye contact and smiling.
d. Showing interest and concern.
e. Questioning techniques and customer qualification.
f. Giving clear non-technical explanations.
g. Confirming understanding (statement/question technique, reflective summary).
h. Written communication – purpose, content, presentation and style.
i. Providing a high quality service – fulfilling (ideally exceeding) customer expectations within agreed time frames.
j. Obtaining customer feedback and corrective actions when dissatisfaction expressed.
k. Dealing with complaints.

Company Products and Services

a. Service standards
    i. national
    ii. manufacturer
    iii. organisational
b. The range and type of services offered by the organisation.
    i. diagnostic.
    ii. servicing.
    iii. repair.
    iv. warranty.
    v. MOT testing.
    vi. fitment of accessories/enhancements.
    vii. internal.
c. The courses of action available to resolve customer problems.
    i. the extent and nature of the work to be undertaken.
    ii. the terms and conditions of acceptance.
    iii. the cost.
    iv. the timescale.
    v. required payment methods.
d. The effect of resource availability upon the receipt of customer vehicles and the completion of work.

   i. levels and availability of equipment.
   ii. levels and availability of technicians.
   iii. workshop loading systems.

e. How to access costing and work completion time information.
   i. manuals.
   ii. computer based.

Vehicle Information Systems, Servicing and Repair Requirements

a. Accessing technical data including diagnostics.
b. Servicing to manufacturer requirements/standards.
c. Repair/operating procedures.
d. MOT standards/requirements.
e. Quality controls – interim and final.
f. Requirements for cleanliness of vehicle on return to customer.
g. Handover procedures.

Consumer Legislation To include:

a. consumer protection
b. sale of goods
c. data protection
d. product liability
e. health and safety
f. discrimination

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Assessment Requirements

Unit LV01K – Knowledge of Routine Light Vehicle Maintenance

Content:

a Vehicle maintenance, inspection and adjustment and record findings
b Vehicle inspection techniques used in routine maintenance including:
  i. aural
  ii. visual and functional assessments on engine
  iii. engine systems
  iv. chassis systems
  v. wheels and tyres
  vi. transmission system
  vii. electrical and electronic systems
  viii. exterior vehicle body
  ix. vehicle interior
c The procedures used for inspecting the condition and serviceability of the following:
  a. filters
  b. drive belts
  c. wiper blades
  d. brake linings
  e. pads
  f. tyres
  g. lights
d Preparation and use appropriate use of equipment to include:
  i. test instruments
  ii. emission equipment
  iii. wheel alignment
  iv. beam setting equipment
  v. tyre tread depth gauges
e Procedures for checking and replenishing fluid levels:
  i. oil
  ii. water
  iii. hydraulic fluids
f Procedures for checking and replacement of lubricants:
  i. replace oil filters
  ii. check levels
  iii. types of oil
  iv. cleanliness
  v. disposal of old oil and filters
g Procedures for carrying out adjustments on vehicle systems or components:
  i. clearances
  ii. settings
  iii. alignment
  v. operational performance (engine idle, exhaust gas)
h Procedures for checking electrical systems:
  i. operation
  ii. security
  iii. performance
i Importance and process of detailed inspection procedures:
  i. following inspection checklists
  ii. checking conformity to manufacturer's specifications

iii. UK and European legal requirements

j Importance and process of completing all relevant documentation relating to routine maintenance:
   i. inspection records
   ii. job cards
   iii. vehicle repair records
   iv. in-vehicle service history

k. The need to use vehicle protection prior to repair
   Requirements and methods used for protecting:
   i. vehicle body panels
   ii. paint surfaces
   iii. seats
   iv. carpets and floor mats

l. The need to check the vehicle following routine maintenance

m. The need to inspect the vehicle following routine maintenance:
   i. professional presentation of vehicle
   ii. customer perceptions

n. The checks of vehicle following routine maintenance:
   i. removal of oil and grease marks
   ii. body panels
   iii. paint surfaces
   iv. seats
   v. carpets and floor mats
   vi. re-instatement of components

Assessment Requirements

Unit LV02.1K – Knowledge of Light Vehicle Engine Mechanical, Lubrication and Cooling System Units and Components

Content:

Engines

a. Engine types and configurations:
   i. inline
   ii. flat
   iii. vee
   iv. four-stroke cycle and two-stroke cycle for spark ignition and compression ignition engines
   v. naturally aspirated and turbo-charged engines
   vi. hybrid fuel engines
b. Relative advantages and disadvantages of different engine types and configurations.
c. Engine components and layouts:
   i. single (OHC) and multi camshaft (DOHC)
   ii. single and multi cylinder (2, 4, 6, 8 cylinder types)
d. Cylinder head layout and design, combustion chamber and piston design.
e. Calculate compression ratios from given data.
f. The procedures used when inspecting engines
g. The procedures to assess:
   i. serviceability
   ii. wear
   iii. condition
   iv. clearances
   v. settings
   vi. linkages
   vii. joints
   viii. fluid systems
   ix. adjustments
   x. operation and functionality
   xi. security
h. Symptoms and faults associated with mechanical engine operation:
   i. poor performance
   ii. abnormal or excessive mechanical noise
   iii. erratic running
   iv. low power
   v. exhaust emissions
   vi. abnormal exhaust smoke
   vii. unable to start
   viii. exhaust gas leaks to cooling system
   ix. exhaust gas leaks

Lubrication

a. The advantages and disadvantages of wet and dry systems.
b. Engine lubrication system:
   i. splash and pressurised systems
   ii. pumps

iii. pressure relief valve
iv. filters
v. oil ways
vi. oil coolers

c. Terms associated with lubrication and engine oil:
i. full-flow
ii. hydrodynamic
iii. boundary
iv. viscosity
v. multi-grade
vi. natural and synthetic oil
vii. viscosity index
viii. multi-grade

d. The requirements and features of engine oil:
i. operating temperatures
ii. pressures
iii. lubricant grades
iv. viscosity
v. multi-grade oil
vi. additives
vii. detergents
viii. dispersants
ix. anti-oxidants inhibitors
x. anti-foaming agents
xi. anti-wear
xii. synthetic oils
xiii. organic oils
xiv. mineral oils

e. Symptoms and faults associated with lubrication systems:
i. excessive oil consumption
ii. oil leaks
iii. oil in water
iv. low or excessive pressure
v. oil contamination

f. The procedures used when inspecting lubrication system

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

General

a. The preparation, testing and use of tools and equipment used for:
i. dismantling
ii. removal and replacement of engine units and components
b. Appropriate safety precautions:
i. PPE
ii. vehicle protection when dismantling
iii. removal and replacing engine units and components
c. The important of logical and systematic processes.
d. The inspection and testing of engine units and components.
e. The preparation of replacement units for re-fitting or replacement.
f. The reasons why replacement components and units must meet the original specifications (OES) – warranty requirements, to maintain performance and safety requirements.
g. Refitting procedures.
h. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.
i. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction;
i. cleanliness of vehicle interior and exterior
ii. security of components and fittings
iii. re-instatement of components and fittings

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Assessment Requirements

Unit LV02.2K – Knowledge of Light Vehicle Fuel, Ignition, Air and Exhaust System Units and Components

Content:

Fuel - Petrol

a. The function and layout of petrol injection systems:
   i. single and multi-point systems
   ii. injection components
   iii. injection pump
   iv. pump relay
   v. injector valve
   vi. air flow sensor
   vii. throttle potentiometer
   viii. idle speed control valve
   ix. coolant sensor
   x. MAP and air temperature sensors
   xi. mechanical control devices
   xii. electronic control units

b. The operation of single and multi-point petrol injection systems and components:
   i. injection pump
   ii. pump relay
   iii. injector valve
   iv. air flow sensor
   v. throttle potentiometer
   vi. idle speed control valve
   vii. coolant sensor
   viii. MAP and air temperature sensors
   ix. electronic control units
   x. fuel pressure regulators
   xi. fuel pump relays
   xii. lambda exhaust sensors
   xiii. flywheel and camshaft sensors
   xiv. air flow sensors (air flow meter and air mass meter)
   xv. EGR valve

c. The procedures used when inspecting petrol system

Fuel – Diesel

a. The layout and construction of inline and rotary diesel systems.
b. The principles and requirements of compression ignition engines
   i. combustion chambers (direct and indirect injection)
c. The function and operation of diesel fuel injection components:
   i. fuel filters
   ii. sedimenters
   iii. injectors
   iv. injector types (direct and indirect injection)
   v. single
   vi. multi-hole and pintle nozzle types
   vii. governors
   viii. fuel pipes
   ix. glow plugs

x. cold start devices
xi. fuel cut-off solenoid

d. The purpose and operation of:
   i. turbochargers
   ii. construction
   iii. use of inter-coolers

e Explain the procedures for injection pump timing and bleeding the system

f The procedures used when inspecting diesel system

Fuel

a. The meaning of terms related to:
   i. hydro-carbon fuels
   ii. volatility
   iii. calorific value
   iv. flash point
   v. octane value
   vi. cetane value

b. The composition of hydro-carbon fuels:
   i. % hydrogen and carbon in petrol and diesel fuels

c. The composition of air (% nitrogen, oxygen), % of oxygen.

d. The chemically correct air/fuel ratio for petrol engines as 14.7:1 (lambda 1, stoichiometric ratio).

e. Weak and rich air/fuel ratios for petrol engines.

f. Exhaust composition and by-products for chemically correct, rich and weak air/fuel ratios of petrol engines:
   i. water vapour (H_2O)
   ii. nitrogen (N)
   iii. carbon monoxide (CO)
   iv. carbon dioxide (CO_2)
   v. carbon (C)
   vi. hydrocarbon (HC)
   vii. oxides of nitrogen (NOx, NO_2, NO) and particulates

g. The relative advantages and disadvantages of diesel and petrol engines.

h. Symptoms and faults associated with fuel systems
   i. diesel fuel system: air in fuel system, water in fuel, filter blockage, leaks, difficult starting, erratic running, excessive smoke (black, blue, white), engine knock, turbocharger faults
   ii. petrol injection system: leaks, erratic running, excessive smoke, poor starting, poor performance, poor fuel economy, failure to start, exhaust emissions, running-on, excessive fuel consumption and surging

Ignition

a. The layout of electronic ignition systems, advantages over conventional systems (points).

b. Electronic ignition circuits and components:
   i. LT Circuit
   ii. battery
   iii. ignition switch
   iv. electronic trigger devices
   v. capacitor
   vi. HT Circuit
   vii. spark plugs (reach, heat range, electrode features and electrode polarity)
   viii. rotor arm
   ix. distributor (if applicable)
   x. distributor cap
   xi. ignition leads
   xii. ignition coil

xiii. ignition timing advance system

c. The operation electronic system components:
   i. amplifiers
   ii. triggering systems
   iii. inductive pick-ups
   iv. hall generators
   v. optical pulse generators
   vi. control units
d. The operation of amplifier units.
e. Ignition terminology:
   i. dwell angle
   ii. dwell time
   iii. dwell variations
   iv. advance and retard of ignition timing
   v. static and dynamic ignition timing
f. The operation of electronic ignition systems under various conditions and loads to include:
   i. engine idling
   ii. during acceleration
   iii. under full load
   iv. cruising
   v. overrun
   vi. cold starting
g. The principles of engine management systems:
   i. closed loop system
   ii. integrated ignition
   iii. injection systems
   iv. sensors
h. The procedures used when inspecting
   i. ignition system
   ii. engine management
   iii. sensors
I. Symptoms and faults associated with ignition system operation
   i. failure to start hot or cold, erratic running, poor performance, misfire, exhaust emissions misfiring and ignition noise (pinking)

Air supply and exhaust systems

a. The construction and purpose of air filtration systems.
b. The operating principles of air filtration systems.
c. The construction and purpose of the exhaust systems.
d. The operating principles of the systems.
e. Exhaust system design to include silencers and catalytic converters.
f. The procedures used when inspecting induction, air filtration and exhaust systems
g. Symptoms and faults associated with air and exhaust systems
   i. exhaust gas leaks
   ii. air leaks

General

j. The preparation, testing and use of tools and equipment used for:
   iii. dismantling
   iv. removal and replacement of engine units and components
k. Appropriate safety precautions:
   iv. PPE
   v. vehicle protection when dismantling
   vi. removal and replacing engine units and components
l. The important of logical and systematic processes.

m. The inspection and testing of engine units and components.
n. The preparation of replacement units for re-fitting or replacement.
o. The reasons why replacement components and units must meet the original specifications (OES) – warranty requirements, to maintain performance and safety requirements.
p. Refitting procedures.
q. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.
r. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction;
    iv. cleanliness of vehicle interior and exterior
    v. security of components and fittings
    vi. re-instatement of components and fittings

Assessment Requirements

Unit LV03K – Knowledge of Light Vehicle Electrical Units and Components

Content:

Electrical/Electronic Principles

a. Electrical units:
    i. volt (electrical pressure)
    ii. ampere (electrical current)
    iii. ohm (electrical resistance)
    iv. watt (power)
b. The requirements for an electrical circuit:
    i. battery
    ii. cables
    iii. switch
    iv. current consuming device
    v. continuity
c. The direction of current flow and electron flow.
d. Series and parallel circuits to include:
    i. current flow
    ii. voltage of components
    iii. volt drop
    iv. resistance
    v. the effect on circuit operation of open circuit component(s)
e. Earth and insulated return systems.
f. Cable sizes and colour codes.
g. Different types of connectors, terminals and circuit protection devices.
h. Common electrical and electronic symbols.

i. The meaning of:
    i. short circuit
    ii. open circuit
    iii. bad earth
    iv. high resistance
    v. electrical capacity
j. The principles of vehicle electronic systems and component.
k. Interpret vehicle wiring diagrams to include:
    i. vehicle lighting
    ii. auxiliary circuits
    iii. indicators
    iv. starting and charging systems
l. Function and construction of electrical components including:
    i. circuit relays
    ii. bulb types
    iii. fan and heater
    iv. circuit protection
m. The safety precautions when working on electrical and electronic systems to include:
    i. disconnection and connection of battery
    ii. avoidance of short circuits
    iii. power surges
    iv. prevention of electric shock
    v. protection of electrical and electronic components
    vi. protection of circuits from overload or damage
n. The set-up and use of:
    i. digital and analogue multi-meters
    ii. voltmeter
    iii. ammeter
    iv. ohmmeter
    v. oscilloscope
    vi. manufacturer's dedicated test equipment

o. Electrical and electronic checks for electrical and electronic systems to include:
    i. connections
    ii. security
    iii. functionality
    iv. performance to specifications
    v. continuity, open circuit
    vi. short circuit
    vii. high resistance
    viii. volt drop
    ix. current consumption
    x. output patterns (oscilloscope)

p. Symptoms and faults associated with electrical and electronic systems to include:
    i. high resistance
    ii. loose and corroded connections
    iii. short circuit
    iv. excessive current consumption
    v. open circuit
    vi. malfunction
    vii. poor performance
    viii. battery faults to include flat battery
    ix. failure to hold charge
    x. low state of charge

xi. overheating
xii. poor starting

Battery and Charging

a. The construction and operation of vehicle batteries including:
   i. low maintenance and maintenance free
   ii. lead acid and nickel cadmium types
   iii. cells
   iv. separators
   v. plates
   vi. electrolyte
b. The operation of the vehicle charging system:
   i. alternator
   ii. rotor
   iii. stator
   iv. slip ring
   v. brush assembly
   vi. three phase output
   vii. diode rectification pack
   viii. voltage regulation
   ix. phased winding connections
   x. cooling fan
   xi. alternator drive system

Starting

a. The layout, construction and operation of engine starting systems: inertia and pre-engaged principles.
b. The function and operation of the following components:
   i. inertia and pre-engaged starter motor
   ii. starter ring gear
   iii. pinion
   iv. starter solenoid
   v. ignition/starter switch
   vi. starter relay (if appropriate)
   vii. one-way clutch (pre-engaged starter motor)

Lighting

a. Function and construction of electrical components including:
   v. front and tail lamps
   vi. main and dip beam headlamps
   vii. fog and spot lamps
   viii. lighting and dip switch
   ix. directional indicators
b. The circuit diagram and operation of components for:
   i. side and tail lamps
   ii. headlamps
   iii. interior lamps
   iv. fog and spot lamps
   v. direction indicators
c. The statutory requirements for vehicle lighting when using a vehicle on the road.
d. Headlamp adjustment and beam setting.

Auxiliary Systems

a. Function and construction of electrical components including:
   i. central door locking

   ii. anti theft devices
   iii. manual locking and dead lock systems
   iv. window winding
   v. demisting systems
   vi. door mirror operation mechanisms
   vii. interior lights and switching
   viii. sun roof operation

b. The circuit diagram and operation of components for:
   i. central door locking
   ii. anti theft devices
   iii. manual locking and dead lock systems
   iv. window winding
   v. demisting systems
   vi. door mirror operation mechanisms
   vii. sun roof operation

c. Comfort and convenience systems to include:
   i. heated seats
   ii. electrically adjusted seats
   iii. heated screens
   iv. electric mirrors
   v. heating
   vi. climate control
   vii. air conditioning

General

a. The preparation, testing and use of:
   i. tools and equipment
   ii. electrical meters and equipment used for dismantling
   iii. removal and replacement of electrical and electronic systems and components
b. Appropriate safety precautions:
   i. PPE
   ii. vehicle protection when dismantling
   iii. removal and replacing electrical and electronic components and systems
c. The important of logical and systematic processes.
d. Preparation of replacement units for re-fitting or replacement electrical and electronic components and systems.
e. The reasons why replacement components and units must meet the original specifications (OES) – warranty requirements, to maintain performance, safety requirements.
f. Refitting procedures.
g. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.
h. Inspection and re-instatement of the vehicle following repair to ensure:
   i. customer satisfaction
   ii. cleanliness of vehicle interior and exterior
   iii. security of components and fittings
   iv. re-instatement of components and fittings

Assessment Requirements

Unit LV04K – Knowledge of Light Vehicle Chassis Units and Components

Content:

Steering

a. The action and purpose of steering geometry:
   i. castor angle
   ii. camber angle
   iii. kingpin or swivel pin inclination
   iv. negative offset
   v. wheel alignment (tracking) (toe in and toe out)
   vi. toe out on turns
   vii. steered wheel geometry
b. The following terms associated with steering:
   i. Ackerman principle
   ii. slip angles
   iii. self-aligning torque oversteer and understeer
   iv. neutral steer
c. The components and layout of hydraulic power steering systems:
   i. piston and power cylinders
   ii. drive belts and pumps
   iii. hydraulic valve (rotary, spool and flapper type)
   iv. hydraulic fluid
d. The advantages of power assisted steering
e. The operation of hydraulic power steering.
f. The principles of electronic power steering systems.
g. The procedures used for inspecting the serviceability and condition of:
   i. manual steering
   ii. power steering
h. Steering system defects to include:
   i. uneven tyre wear
   ii. wear on outer edge of tyre
   iii. wear on inner edge of tyre
   iv. uneven wear
   v. flats on tread
   vi. steering vibrations
   vii. wear in linkage
   viii. damage linkage
   ix. incorrect wheel alignment
   x. incorrect steering geometry

Suspension

a. The layout and components of suspension systems:
   i. non-independent suspensions
   ii. independent front suspension (IFS)
   iii. independent rear suspension (IRS)
   iv. hydraulic
   v. hydro-pneumatic
   vi. rigid axle types
b. The operation of suspension systems and components:

i. leaf and coil springs
ii. torsion bar
iii. rubber springs
iv. Macpherson strut system
v. hydraulic
vi. hydro-pneumatic
vii. hydraulic dampers
viii. trailing arms
ix. wish bones
x. ball joints
xi. track control arms
xii. bump stops
xiii. anti-roll bars
xiv. stabiliser bars
xv. swinging arms
xvi. parallel link
xvii. swinging half-axles
xviii. transverse link
xix. semi-swinging arms

c. The advantages of different systems including:
i. non-independent
ii. independent suspension (IFS)
iii. independent suspension (IRS)
iv. hydraulic
v. hydro-pneumatic
vi. rigid axle

d. The principles of electronic suspensions systems.
e. The forces acting on suspension systems during braking, driving and cornering.
f. The methods of locating the road wheels against braking, driving and cornering forces.
g. The methods of controlling cornering forces by fitting anti-roll torsion members
h. Suspension terms:
i. rebound
ii. bump
iii. float
iv. dive
v. pitch
vi. roll
vii. compliance

i. The procedures used for inspecting the serviceability and condition of the suspension system
j. Suspension system defects:
i. wheel hop
ii. ride height (unequal and low)
iii. wear
iv. noises under operation
v. fluid leakage
vi. excessive travel
vii. excessive tyre wear
viii. bounce
ix. poor vehicle handling
x. worn dampers
xi. worn joints
xii. damaged linkages

Brakes

a. The construction and operation of drum brakes:
   i. leading and trailing shoe construction
   ii. self-servo action
   iii. automatic adjusters
   iv. backing plates
   v. parking brake system
b. The construction and operation of disc brakes:
   i. disc pads
   ii. calliper
   iii. brake disc
   iv. ventilated disc
   v. disc pad retraction
   vi. parking brake system
   vii. electrical and electronic components
   viii. wear indicators and warning lamps

c. The construction and operation of the hydraulic braking system:
   i. single and dual line layout
   ii. master cylinders
   iii. wheel cylinders
   iv. disc brake calliper & pistons
   v. brake pipe
   vi. brake servo
   vii. warning lights
   viii. parking brakes
   ix. equalising valves
d. The principles and components of electronic ABS systems, electrical and electronic components.
e. The requirements and hazards of brake fluid:
   i. boiling point
   ii. hygroscopic action
   iii. manufacturer's change periods
   iv. fluid classification and rating
   v. potential to damage paint surfaces
f. Terms associated with mechanical and hydraulic braking systems:
   i. braking efficiency
   ii. brake fade
   iii. brake balance
   iv. ABS
g. The procedures used for inspecting the serviceability and condition of the braking system
h. Braking system defects:
   i. worn shoes or pads
   ii. worn or scored brake surfaces
   iii. abnormal brake noises
   iv. brake judder
   v. fluid contamination of brake surfaces
   vi. fluid leaks
   vii. pulling to one side
   viii. poor braking efficiency
   ix. lack of servo assistance
   x. brake drag
   xi. brake grab

xii. brake fade

Wheel and Tyres

a. The construction of different types of tyre:
   i. radial
   ii. cross ply
   iii. bias belted
   iv. tread patterns
   v. tyre mixing regulations
   vi. tyre applications
b. Tyre markings:
   i. tyre and wheel size markings
   ii. speed rating
   iii. direction of rotation
   iv. profile
   v. load rating
   vi. ply rating
   vii. tread-wear indicators
c. Wheel construction:
   i. light alloy
   ii. pressed steel and wire wheels
   iii. flat-edge and double hump rims
d. Types of wheel bearing arrangements:
   i. non-driving
e. Types of bearing used for wheel bearing arrangements:
   i. roller
   ii. taper roller
   iii. needle
   iv. ball and plain
f. The procedures used for inspecting the serviceability and condition of:
   iii. tyres & wheels
   iv. bearings
g. The defects associated with tyres and wheels:
   i. abnormal tyre wear
   ii. cuts
   iii. side wall damage
   iv. wheel vibrations
   v. tyre noise (squeal during cornering)
   vi. tyre over heating (low pressure)
   vii. tread separation

General

The procedures for dismantling, removal and replacement of chassis system components

a. The preparation:
   i. testing and use of tools and equipment
   ii. electrical meters and equipment used for dismantling
   iii. removing and replacing chassis systems and components
b. Appropriate safety precautions:
   i. PPE
   ii. vehicle protection when dismantling
   iii. removing and replacing chassis systems and components
c. The important of logical and systematic processes.
d. The inspection and testing of chassis systems and components.

e. The preparation of replacement units for re-fitting or replacement of chassis systems or components.
f. Identify the reasons why replacement components and units must meet the original specifications (OES):
    i. warranty requirements
    ii. to maintain performance
    iii. safety requirements
g. Refitting procedures.
h. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.
i. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:
    i. cleanliness of vehicle interior and exterior
    ii. security of components and fittings
    iii. re-instatement of components and fittings

Assessment Requirements

Unit LV0506K – Knowledge of Inspecting Light Vehicles Using Prescribed Methods

Content:

Pre and post work vehicle inspections and record findings

a. PPE and vehicle protection relating to:
    i. vehicle body panels
    ii. paint surfaces
    iii. seats
    iv. carpets and floor mats prior to conduction vehicle inspections
b. Pre and post work vehicle inspection procedures:
    i. aural
    ii. visual and functional assessments on engine
    iii. engine systems
    iv. chassis systems
    v. wheels and tyres
    vi. transmission system
    vii. electrical and electronic systems
    viii. exterior vehicle body
    ix. vehicle interior
c. The methods for carrying out inspections for: damage, corrosion, fluid leaks, wear, security, mounting security and condition to include;
    i. engines and engine systems
    ii. chassis systems
    iii. brakes
    iv. steering
    v. suspension
    vi. wheels
    vii. tyres
    viii. body panels
    ix. electrical and electronic systems and components
    x. vehicle seating and vehicle interior
    xi. vehicle instrumentation
    xii. driver controls
d. Check conformity to manufacturer's specifications and legal requirements.
e. Completion of documentation to include:
    i. inspection records
    ii. job cards
    iii. vehicle records
f. Make recommendations based on results of vehicle inspections.
g. The checks necessary to ensure customer satisfaction for:
    i. vehicle body panels
    ii. paint surfaces
    iii. seats
    iv. carpets and floor mats following pre or post vehicle inspections
h. Prepare and use appropriate inspection equipment and tools.
i. Inspection procedures following inspection checklists.

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. CO_2
   iii. O
   iv. N
   v. H_2O
   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

Assessment Requirements

Unit LV08K – Knowledge in Diagnosis and Rectification of Light Vehicle Chassis Faults

Content:

Electrical and electronic principles of light vehicle chassis systems

a. The operation of electrical and electronic systems and components related to light vehicle chassis systems including:
   i. ECU
   ii. sensors and actuators
   iii. electrical inputs
   iv. voltages
   v. oscilloscope patterns
   vi. digital and fibre optic principles
b. The interaction between the electrical/electronic system and mechanical components of chassis systems.
c. Electronic and electrical safety procedures.

Operation of electronic ABS and EBD braking systems

a. Layout of:
   i. ABS and EBD braking systems
   ii. anti-lock braking
   iii. anti-skid control systems
   iv. warning systems
b. Operation of:
   i. hydraulic and electronic control units
   ii. wheel speed sensors
   iii load sensors
   iii. hoses
   iv. cables and connectors
c. Advantage of ABS and EBD braking systems over conventional braking systems.
d. The relationship and interaction of ABS braking with and other vehicle systems – traction control.

Steering geometry for light vehicle applications

a. Non-steered wheel geometry settings.
b. Front/rear wheel geometry:
   i. castor
   ii. camber
   iii. kingpin or swivel pin inclination
   iv. negative offset
   v. wheel alignment (tracking)
   vi. toe in and toe out
   vii. toe out on turns and steered wheel geometry
   viii. Ackerman principle
   ix. slip angles
   x. self-aligning torque
   xi. oversteer and understeer
   xii. neutral steer
c. The operation and layout of rear and four wheel steering.
d. The construction and operation of power assisted steering systems:

   i. hydraulic system
   ii. power cylinders
   iii. drive belts and pumps
   iv. hydraulic valve (rotary, spool and flapper type)
e. The operation of:
   i. electronic power steering systems (EPS)
   ii. electrical and electronic components

Components and operation of self-levelling suspension

a. The components, construction and operation of a self levelling suspension system.
b. The operation of self -levelling suspension system under various conditions:
   i. self-energising
   ii. pump operated self-levelling suspension

Operation of fitting ride-controlled systems.

a. The reasons for fitting ride controlled systems.
b. The operation of driver controlled and ride controlled systems.

Symptoms and faults in braking systems

a. Symptoms and faults associated with conventional braking systems, ABS, and EBD systems:
   i. mechanical
   ii. hydraulic
   iii. electrical and electronic systems
   iv. fluid leaks
   v. warning light operation
   vi. poor brake efficiency
   vii. wheel locking under braking

Diagnosis and faults in braking systems

a. Locate and interpret information for:
   i. diagnostic tests
   ii. vehicle and equipment specifications
   iii. use of equipment
   iv. testing procedures
   v. test plans
   vi. fault codes
   vii. legal requirements
b. Prepare equipment for use in diagnostic testing.
c. Conduct systematic testing and inspection of:
   i. braking system
   ii. ABS
   iii. EBD
   iv. mechanical
   v. hydraulic
   vi. electrical and electronic systems
d. Using appropriate tools and equipment including:
   i. multi-meters
   ii. oscilloscope
   iii. pressure gauges
e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.
h. Assess, examine and evaluate the operation, settings, values, condition and performance of components and systems.
i. Probable faults, malfunctions, incorrect settings.

j. Rectification or replacement procedures.
k. Operation of systems following diagnosis and repair to confirm operation and performance.

Symptoms and faults associated with steering systems

a. Symptoms and faults associated with steering systems:
    i. mechanical
    ii. hydraulic
    iii. electrical and electronic
    iv. steering boxes (rack and pinion, worm and re-circulating ball)
    v. steering arms and linkages
    vi. steering joints and bushes
    vii. idler gears
    viii. bearings
    ix. steering columns (collapsible and absorbing)
    x. power steering system

Diagnosis and faults in steering systems

a. Locate and interpret information for:
    i. diagnostic tests
    ii. vehicle and equipment specifications
    iii. use of equipment
    iv. testing procedures
    v. test plans
    vi. fault codes
    vii. legal requirements
b. How to prepare equipment for use in diagnostic testing.
c. Conduct systematic testing and inspection of:
    i. steering systems
    ii. mechanical
    iii. hydraulic
    iv. electrical and electronic systems
    v. power steering system
d. Using appropriate tools and equipment including:
        i. multi-meters
        ii. oscilloscope
        iii. pressure gauges
        iv. wheel alignment equipment
        v. steering geometry equipment
e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.
h. Assess, examine and evaluate the:
    i. operation
    ii. settings
    iii. values
    iv. condition and performance of components and systems
i. Probable faults, malfunctions, and incorrect settings.
j. Rectification or replacement procedures.
k. Operation of systems following diagnosis and repair to confirm operation and performance.

Symptoms and faults associated with suspension systems

a. Symptoms and faults associated with suspension systems:
    i. mechanical
    ii. hydraulic
    iii. electrical and electronic

iv. conventional
v. self-levelling and ride controlled suspension systems
vi. ride height (unequal and low)
vii. wear
viii. noises under operation
ix. fluid leakage
x. excessive travel
xi. excessive tyre wear

Diagnosis and faults in suspension systems

a. Locate and interpret information for:
   i. diagnostic tests
   ii. vehicle and equipment specifications
   iii. use of equipment
   iv. testing procedures
   v. test plans
   vi. fault codes
   vii. legal requirements
b. How to prepare equipment for use in diagnostic testing.
c. How to conduct systematic testing and inspection of:
   i. suspension systems
   ii. mechanical
   iii. hydraulic
   iv. electrical and electronic systems
   v. conventional
   vi. self-levelling and ride controlled suspension systems
d. Using appropriate tools and equipment including:
   i. multi-meters
   ii. oscilloscope
   iii. pressure gauges
   iv. alignment equipment
   v. geometry equipment
e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.
h. Assess, examine and evaluate the operation, settings, values, condition and performance of components and systems.
i. Probable faults, malfunctions and incorrect settings.
j. Rectification or replacement procedures.
k. Operation of systems following diagnosis and repair to confirm operation and performance.

Measurements on components to include:

a. settings
b. input and output values
c. voltages
d. current consumption
e. resistance
f. output patterns with oscilloscope
g. pressures
h. condition
i. wear and performance

Assessment Requirements

Unit LV11.1K – Knowledge of Overhauling Light Vehicle Engine Units

Content:

How the units and assemblies being overhauled operate

a. Identify unit components
b. Understand unit construction
c. Describe unit operation

How units are dismantled and reassembled

a. The dismantling procedure.
b. Tools and equipment used for stripping and rebuilding units and assemblies.
c. Methods of safe storage for removed components during overhaul activities.
d. The process for assessing the condition of sub-assemblies including:
    i. fit
    ii. tolerances
    iii. permitted limits
e. The rebuild procedure for units and assemblies.
f. Adjustment procedures during re-assembly.

Unit and assembly testing and evaluation procedures

a. Appropriate testing and evaluation procedures prior to dismantling units.
b. Appropriate testing and evaluation procedures of components after dismantling units.
c. How to use overhauling and test equipment for the task.
d. The cost-benefit relationship between reconditioning, repair and replacement of components within units.
e. How to test and evaluate the performance of the overhauled units against the operating specification.
f. How to interpret test results.
g. Adjustment procedures during final evaluation.

Faults associated with units and assemblies being overhauled

a. Causes of faults and failures within units and assemblies.
b. The faults associated with units and assemblies.
c. How to make adjustments to meet final specification after testing and evaluation of assembled units and assemblies.

The procedures for dismantling, removal and replacement of units and components

a. The preparation, testing and use of:
    i. tools and equipment
    ii. removal and replacement of electrical and electronic systems and components
b. Appropriate safety precautions:
    i. PPE
    ii. vehicle protection when dismantling
    iii. removal and replacing electrical and electronic components and systems
c. The importance of logical and systematic processes.
d. The reasons why replacement components and units must meet the original specifications (OES) – warranty requirements, to maintain performance, safety requirements.
e. Refitting procedures.

f. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.
g. Inspection and re-instatement of the vehicle following repair to ensure:
    i. customer satisfaction
    ii. cleanliness of vehicle interior and exterior
    iii. security of components and fittings
    iv. re-instatement of components and fittings
    v. cancelling of any fault codes and warning lights

Assessment Requirements

Unit LV11.2K – Knowledge of Overhauling Light Vehicle Transmission Units

Content:

How the units and assemblies being overhauled operate

a. Identify unit components
b. Understand unit construction
c. Describe unit operation

How units are dismantled and reassembled

a. The dismantling procedure.
b. Tools and equipment used for stripping and rebuilding units and assemblies.
c. Methods of safe storage for removed components during overhaul activities.
d. The process for assessing the condition of sub-assemblies including:
    i. fit
    ii. tolerances
    iii. permitted limits
e. The rebuild procedure for units and assemblies.
f. Adjustment procedures during re-assembly.

Unit and assembly testing and evaluation procedures

a. Appropriate testing and evaluation procedures prior to dismantling units.
b. Appropriate testing and evaluation procedures of components after dismantling units.
c. How to use overhauling and test equipment for the task.
d. The cost-benefit relationship between reconditioning, repair and replacement of components within units.
e. How to test and evaluate the performance of the overhauled units against the operating specification.
f. How to interpret test results.
g. Adjustment procedures during final evaluation.

Faults associated with units and assemblies being overhauled

a. Causes of faults and failures within units and assemblies.
b. The faults associated with units and assemblies.
c. How to make adjustments to meet final specification after testing and evaluation of assembled units and assemblies.

The procedures for dismantling, removal and replacement of units and components

a. The preparation, testing and use of:
    i. tools and equipment
    ii. removal and replacement of electrical and electronic systems and components
b. Appropriate safety precautions:
    i. PPE
    ii. vehicle protection when dismantling
    iii. removal and replacing electrical and electronic components and systems
c. The importance of logical and systematic processes.
d. Preparation of replacement units for re-fitting or replacement electrical and electronic components and systems.
e. The reasons why replacement components and units must meet the original specifications (OES) – warranty requirements, to maintain performance, safety requirements.

f. Refitting procedures.
g. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.
h. Inspection and re-instatement of the vehicle following repair to ensure:
    i. customer satisfaction
    ii. cleanliness of vehicle interior and exterior
    iii. security of components and fittings
    iv. re-instatement of components and fittings
    v. cancelling of any fault codes and warning lights

Assessment Requirements

Unit LV11.3K – Knowledge of Overhauling Light Vehicle Steering and Suspension Units

Content:

How the units and assemblies being overhauled operate

a. Identify unit components
b. Understand unit construction
c. Describe unit operation

How units are dismantled and reassembled

a. The dismantling procedure.
b. Tools and equipment used for stripping and rebuilding units and assemblies.
c. Methods of safe storage for removed components during overhaul activities.
d. The process for assessing the condition of sub-assemblies including:
    i. fit
    ii. tolerances
    iii. permitted limits
e. The rebuild procedure for units and assemblies.
f. Adjustment procedures during re-assembly.

Unit and assembly testing and evaluation procedures

a. Appropriate testing and evaluation procedures prior to dismantling units.
b. Appropriate testing and evaluation procedures of components after dismantling units.
c. How to use overhauling and test equipment for the task.
d. The cost-benefit relationship between reconditioning, repair and replacement of components within units.
e. How to test and evaluate the performance of the overhauled units against the operating specification.
f. How to interpret test results.
g. Adjustment procedures during final evaluation.

Faults associated with units and assemblies being overhauled

a. Causes of faults and failures within units and assemblies.
b. The faults associated with units and assemblies.
c. How to make adjustments to meet final specification after testing and evaluation of assembled units and assemblies.

The procedures for dismantling, removal and replacement of electrical and electronic units and components

a. The preparation, testing and use of:
    i. tools and equipment
    ii. removal and replacement of electrical and electronic systems and components
b. Appropriate safety precautions:
    i. PPE
    ii. vehicle protection when dismantling
    iii. removal and replacing electrical and electronic components and systems
c. The importance of logical and systematic processes.
d. Preparation of replacement units for re-fitting or replacement electrical and electronic components and systems.

e. The reasons why replacement components and units must meet the original specifications (OES) – warranty requirements, to maintain performance, safety requirements.
f. Refitting procedures.
g. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.
h. Inspection and re-instatement of the vehicle following repair to ensure:
    i. customer satisfaction
    ii. cleanliness of vehicle interior and exterior
    iii. security of components and fittings
    iv. re-instatement of components and fittings
    v. cancelling of any fault codes and warning lights

Assessment Requirements

Unit LV12K – Knowledge of Light Vehicle Transmission and Driveline Units and Components

Content:

The operation of clutch operating systems

a. Clutch operating mechanisms
    i. pedal and lever
    ii. hydraulic operated
    iii. mechanical
    iv. cable operated
    v. hydraulic components
    vi. master cylinder
    vii. slave cylinder
    viii. hydraulic pipes
    ix. electrical and electronic components (fluid level indicators)

The operation of friction clutches

a. The reasons for fitting a clutch.
b. The construction and operation of:
    i. hydraulically and cable operated clutches
    ii. coil spring clutches
    iii. diaphragm spring clutches
    iv. single plate clutches
    v. multi plate clutches

The operation of manual gearboxes

a. The reasons for fitting gearboxes, to provide neutral, reverse, torque multiplication.
b. Different gearbox types: transverse and inline layouts.
c. The layout and construction of gears and shafts for 4, 5 and 6 speed gearbox designs, sliding mesh, constant mesh and synchromesh gearboxes reverse gear,
d. The construction and operation of:
    i. gear selection linkages
    ii. selector forks and rods
    iii. detents and interlock mechanisms
e. The construction and operation of synchromesh devices.
f. The arrangements for gearbox bearings:
    i. bushes
    ii. oil seals
    iii. gaskets and gearbox lubrication
    iv. speedometer drive
g. The electrical and electronic components including reverse lamp switch
h. Calculate gear ratios and driving torque for typical gearbox specifications.

The operation of driveline components

a. The layout and construction of propshafts and drive shafts used in front wheel, rear wheel and four-wheel drive systems.
b. The reasons for using flexible couplings and sliding joints in transmissions systems.
c. The reason for using constant velocity joints in drive shafts incorporating steering mechanisms.
d. The construction and operation of:

   i. universal joints
   ii. sliding couplings
   iii. constant velocity joints
e. The simple stresses applied to shafts: torsional, bending and shear.
f. The construction and operation of:
   i. final drive units
   ii. crown wheel & pinion
   iii. bevel
   iv. hypoid and helical gears
   v. differential gears
   vi. sun & planet gears
   vii. lubricants
   viii. lubrication bearings and seals
   ix. limited slip differential
g. The reasons for fitting a differential.
h. Calculate final drive gear ratios.
i. Calculate the overall gear ratio from given data (gearbox ratio x final drive ratio).

The testing and inspection techniques used for light vehicle transmission systems

a. The techniques and procedures used for inspecting and testing clutches and clutch mechanisms including:
   i. clearances
   ii. pedal and lever settings
   iii. cables & linkages
   iv. hydraulic system
   v. leaks
   vi. adjustments
   vii. travel
b. The techniques and procedures used for inspecting and testing gearboxes including:
   i. leaks
   ii. gear selection
   iii. synchromesh operation
   iv. abnormal noise
c. The techniques and procedures used for inspecting and testing drive line systems (prop & drive shafts, couplings) including:
   i. security
   ii. serviceability of rubber boots
   iii. leaks
   iv. alignment
   v. balance weights (where applicable)
d. The techniques used when inspecting and testing final drive systems including:
   i. fluid levels
   ii. leaks
   iii. noise

The faults and symptoms associated with vehicle transmissions systems

a. The faults and symptoms associated with transmission systems:
   i. clutch faults
   ii. gearbox faults
   iii. drive line faults (propshaft, drive shaft
   iv. universal and constant velocity joints)
   v. universal joint alignment
   vi. final drive faults
b. Faults and symptoms to include mechanical, electrical and hydraulic systems.

The procedures for dismantling, removal and replacement of transmission units and components

a. The preparation, testing and use of tools and equipment, electrical meters and equipment used for
   dismantling removing and replacing transmission systems and components.
b. appropriate safety precautions:
   i. PPE
   ii. vehicle protection when dismantling
   iii. removing and replacing transmission systems and components
c. The importance of logical and systematic processes.
d. The inspection and testing of transmission systems and components
e. The preparation of replacement units for re-fitting or replacement of transmission systems or components.
f. The reasons why replacement components and units must meet the original specifications (OES):
   i. warranty requirements
   ii. to maintain performance
   iii. safety requirements
g. Refitting procedures.
i. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.
j. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:
   i. cleanliness of vehicle interior and exterior
   ii. security of components and fittings
h. re-instatement of components and fittings

Types of wheel bearing arrangements:
   i. driven wheels
   ii. fully floating
   iii. three quarter floating
   iv. semi floating axles

Assessment Requirements

Unit LV13K – Knowledge of Diagnosis and Rectification of Light Vehicle Transmission and Driveline Faults

Content:

Electrical and electronic principles related to light vehicle transmission systems

a. The operation of electrical and electronic systems and components related to light vehicle transmission systems including:
    i. ECU
    ii. sensors and actuators
    iii. electrical inputs & outputs
    iv. voltages
    v. oscilloscope patterns
    vi. digital and fibre optic principles
b. The interaction between the electrical/electronic system, hydraulic system and mechanical components of the transmission systems.
c. Electronic and electrical safety procedures.

The operation light vehicle clutches and fluid couplings

a. The construction and operation of friction clutches (coil spring, diaphragm) including single and twin clutch designs.
b. The construction and operation of fluid couplings including:
    i. fluid flywheel
    ii. torque converter (torque multiplication, efficiency)
    iii. benefits of fluid couplings
    iv. benefits of torque converter over fluid flywheel

The operation of light vehicle transmissions and driveline systems

a. The construction and operation of manual gearboxes:
    i. 4, 5 & 6 speed gearboxes
    ii. gear arrangements
    iii. shaft and bearing arrangements
    iv. synchromesh devices
    v. interlock mechanisms
    vi. linkages
    vii. overdrive
    viii. lubrication
b. The construction and operation of automatic gearboxes including hydraulic and electronic control systems: operations of epicyclic gears (sun, planet, annulus and carrier), method for achieving different gear ratios using epicyclic gearing; hydraulic control systems, components and operation; electronic control system, components and operation.
c. The construction and operation of continuously variable transmissions (CVT) and the benefits of this type of gearbox design.
d. The construction and operation of the sequential manual gearbox (SMG).
e. The construction and operation of final drive systems including:
    i. conventional crown wheel and pinion
    ii. differential gears
    iii. limited slip differential
f. The construction and operation of light vehicle 4 wheel drive systems including third differential and differential locks.
g. The operation of light vehicle traction control systems and launch control.

h. The construction and operation of light vehicle hub arrangements.
i. The construction and operation of:
    i. drive shafts
    ii. prop shafts including flexible joints and couplings
    iii. universal joints
    iv. constant velocity joints
    v. sliding joints

Symptoms and faults in light vehicle transmissions and drive-line systems

a. Clutch and coupling faults:
    i. abnormal noises
    ii. vibrations
    iii. fluid leaks
    iv. slip
    v. judder
    vi. grab
    vii. failure to release
b. Gearbox faults:
    i. abnormal noises
    ii. vibrations
    iii. loss of drive
    iv. difficulty engaging or disengaging gears
    v. automatic gear box types
    vi. abnormal noises
    vii. vibrations
    viii. loss of drive
    ix. failure to engage gear
    x. failure to disengage gear
    xi. leaks
    xii. failure to operate
    xiii. incorrect shift patterns
    xiv. electrical and electronic faults
c. Final drive faults:
    i. abnormal noises
    ii. vibrations
    iii. loss of drive
    iv. oil leaks
    v. failure to operate
    vi. electrical and electronic faults
d. Drive-lines and couplings:
    i. abnormal noises
    ii. vibrations
    iii. loss of drive

Faults in light vehicle transmission systems

a. Interpret information for diagnostic tests, vehicle and equipment specifications, use of equipment, testing procedures, test plans, fault codes and legal requirements.
b. How to prepare equipment for use in diagnostic testing.
c. How to conduct systematic testing and inspection of transmission system, mechanical, hydraulic, electrical and electronic systems using appropriate tools and equipment including, mullet-meters, oscilloscope and pressure gauges.
d. How to carry out workshop based and road testing of vehicle and transmission system.
e. Evaluate and interpret test results from diagnostic and/or road testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.

h. Assess, examine and evaluate the operation, settings, values, condition and performance of components and systems.
i. Probable faults, malfunctions and incorrect settings.
j. Rectification or replacement procedures.

Operation of systems following diagnosis and repair to confirm operation and performance.

Measurements on components to include:

i. Settings
ii. input and output values
iii. voltages
iv. current consumption
v. resistance
vi. output patterns with oscilloscope
vii. pressures
viii. condition
ix. wear and performance

Assessment Requirements

Unit AE06K – Knowledge of Diagnosis and Rectification of Automotive Auxiliary Electrical Faults

Content:

The electrical principles that are related to light vehicle electrical circuits:

a. Ohms law
b. Voltage
c. Power
d. Current (AC and DC)
e. Resistance
f. Magnetism
g. Electromagnetism and electromagnetic induction
h. Digital and fibre optic principles
i. Electrical units and symbols
j. Electrical and electronic terminology
k. Relevant electrical safety

Battery and Charging

a. The construction and operation of vehicle batteries including:
    i. low maintenance and maintenance free
    ii. lead acid and nickel cadmium types
    iii. cells
    iv. separators
    v. plates
    vi. electrolyte
b. The operation of the vehicle charging system:
    i. alternator
    ii. rotor
    iii. stator
    iv. slip ring
    v. brush assembly
    vi. three phase output
    vii. diode rectification pack
    viii. voltage regulation
    ix. phased winding connections
    x. cooling fan
    xi. alternator drive system

Starting

a. The layout, construction and operation of engine starting systems: inertia and pre-engaged principles.
b. The function and operation of the following components:
    i. inertia and pre-engaged starter motor
    ii. starter ring gear
    iii. pinion
    iv. starter solenoid
    v. ignition/starter switch
    vi. starter relay (if appropriate)
    vii. one-way clutch (pre-engaged starter motor)

Lighting systems and technology

a. Lighting systems should include:
    i. Xenon lighting
    ii. gas discharge lighting
    iii. ballast system
    iv. LED
    v. intelligent front lighting
    vi. blue lights
    vii. complex reflectors
    viii. fibre optic
    ix. optical patterning

Lighting circuits and the relationship between each circuit

a. Circuits must include:
    i. Sidelights including number plate lights and marker lights
    ii. dipped beam
    iii. main beam
    iv. dim/dip
    v. indicators and hazard lights
    vi. high intensity and fog light

Common faults and testing methods associated with external lighting system

a. Fault diagnosis for:
    i. lighting systems failing to operate correctly
    ii. switches
    iii. relays
    iv. bulbs failing to operate

The operating principles of external lighting systems and multiplexing systems

a. To include all external lighting systems and a good knowledge of multiplexing systems.

The different types of electric windows, and mirror systems and components

a. Components should include:
    i. window
    ii. mirror motors
    iii. multi-functional switches
    iv. relays
    v. total closure modules

The function of component parts in the electric window and mirror systems

a. Components must include:
    i. motors
    ii. relays
    iii. interfaces
    iv. modules
    v. switches

The operating principles of electric windows and mirror systems

a. Operating principles of the following:
    i. motors
    ii. interfaces
    iii. switches
    iv. modules

Common faults and testing methods associated with electric windows mirror systems

a. Fault diagnosis for:
   i. electric windows failing to open or close
   ii. electric mirrors fail to adjust
   iii. slow operation on both systems

The different types of screen heating systems and components

a. Systems must include:
   i. heated front screens
   ii. heated rear screens
   iii. heated mirrors

The function and operating principles of components for heated screen and mirror systems

a. Components must include:
   i. front screen elements
   ii. mirror elements
   iii. time control relays
   iv. multifunction relays and switches

Common faults and testing methods associated with heated screen and mirror systems

a. Faults must include:
   i. screen elements not operating
   ii. timer relays not operating and staying on permanently

The different types of In Car Entertainment (ICE) systems and components

a. Systems and components must include:
   i. radio CD and multi play units
   ii. DVD players
   iii. MP3 players
   iv. speakers
   v. aerial systems
   vi. amplifiers
   vii. V.D.U. screens
   viii. Satellite Navigation
   ix. communication units

The function of components in ICE systems

a. Systems include:
   i. radios
   ii. CD players
   iii. video players
   iv. DVD players
   v. aerial systems
   vi. speakers
   vii. amplifiers
   viii. VDU screens
   ix. mobile communication units

The operating principles of ICE systems

a. Operation of entertainment systems speaker and aerial systems

Common faults and testing methods associated with ICE systems

a. Faults to include:
   i. entertainment and navigation units not operating

ii. speaker, aerial and amplifier systems not functioning correctly
iii. excessive radio interference (suppression)
iv. use of diagnostic computers and systems

The different types of integrated security/warning systems and components

a. Components to include:
   i. control units
   ii. alarm modules
   iii. audible warning units
   iv. immobiliser units
   v. sensing units
   vi. horn
   vii. audible warning speakers

The function of component parts in integrated security and warning systems

a. Components to include
   i. control units
   ii. alarm modules
   iii. audible warning units
   iv. interior sensing systems
   v. immobiliser units
   vi. relays
   vii. LED's
   viii. horns

The operating principles of integrated security and warning systems

a. Operation of alarm systems and audible warning units.

The relevant legislation relevant to security and warning systems

a. Find and apply all relevant legislation for the fitment and use of security and warning systems.

Common faults and testing methods associated with security and warning systems

a. Components to include:
   i. control units
   ii. audible warning units
   iii. immobiliser units
   iv. horns
   v. relays
   vi. LED's
   vii. wiring
   viii. connections and protection devices
   ix. removal and refitting procedures
   x. using computer diagnostics to identify faults
   xi. use of manufacturers diagnostic equipment

The different wiper system components

a. Components must include:
   i. wiper motors
   ii. washer motors
   iii. wiper linkage
   iv. multifunction relays
   v. headlamp wash/wipe

The function of component wiper and washer components

a. Components and systems must include:

i. wiper motors
ii. intermittent wash wipe relays
iii. parking systems

The operating principles, faults and testing methods of wiper and washer systems

a. Principles, fault diagnosis and testing for:

i. wiper motors failing
ii. damaged linkages
iii. incorrect operation of intermittent and parking systems
iv. earth faults
v. control unit failure

The different heater, cooling system components and air con.

a. Components include:

i. heater motors
ii. speed rheostats,
iii. switches
iv. valves
v. radiator cooling fan motors
vi. relays
vii. air conditioning units

The function of component heater, cooling parts and air conditioning

a. Components include:

i. heater motors
ii. rheostats
iii. valves
iv. switches
v. relays
vi. cooling fan motors
vii. air conditioning units
viii. thermostatic switches

The operating principles of heater, cooling systems and air conditioning

a. Principles to include:

i. conduction
ii. convection
iii. radiation
iv. circulation
v. boiling points
vi. states of matter (Gas, liquid, solid)
vii. temperature control
viii. antifreeze mixtures
ix. heat transfer

Common faults and testing methods associated with heater, cooling systems and air conditioning

a. Fault diagnosis for:

i. heater motor failing to operate on all/one speed
ii. radiator cooling fan not operating
iii. valves
iv. relays

v. switches not operating
vi. electrical related faults on the air conditioning system

The different types of locking system components
a. Door locking actuators, solenoids, deadlocking actuators, anti-theft modules.

The function of component parts in the locking system
a. Solenoids, actuators (electrical and pneumatic), multifunctional relays, anti-theft modules and release systems.

The operating principles of locking systems
a. Doors and cabs

Common faults and testing methods associated with locking systems
a. Door locking actuators, solenoids, connections, wiring, relays, and protection devices/fuses

The different types of Supplementary Restraint and Airbag systems
a. Components include:
   i. control units
   ii. sensors
   iii. seat belt pretensioners
   iv. airbag assemblies
   v. wiring systems
   vi. warning systems

The function of component parts in the Supplementary Restraint and Airbag systems
a. Components include:
   i. control units
   ii. interfaces
   iii. sensors
   iv. airbag units
   v. pretensioners

The operating principles of Supplementary Restraint and Airbag systems
a. Operation of the sensors.
b. Operation of the airbag unit.
c. Operation of the various types of pretension.
d. Safe handling procedures and regulations.

Common faults and testing methods associated Supplementary Restraint and Airbag systems
a. Fault diagnosis for Airbag and SRS faults:
   i. fault code identification
   ii. wiring faults
   iii. component failure
   iv. earth problems
   v. sensor faults.

How to examine, measure and make suitable adjustments to components are:
a. Settings
b. Input and output values
c. Voltages
d. Current consumption
e. Resistance

f. Input and output patterns with oscilloscope (including frequency and duty cycle measurements)
g. Condition
h. Wear and performance

How to select, prepare and use diagnostic and rectification equipment for automotive auxiliary electrical systems:

a. Voltmeters
b. Ammeters
c. Ohmmeters
d. Multi-meters
e. Battery testing equipment
f. Dedicated and computer based diagnostic equipment
g. Oscilloscopes

Assessment Requirements

Unit BP18K – Knowledge of Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-Permanently Fixed Vehicle Body Panels

Content:

Describe procedures to prevent damage to the vehicle, components and contents when removing, storing and refitting basic MET components

a. The methods that can be used to protect undamaged items to ensure they are removed and refitted without causing unnecessary damage:
   i. bumpers
   ii. headlamp units
   iii. road wheels
   iv. batteries
   v. bonnet and boot trim
   vi. interior trim components
   vii. exterior trim components

b. The procedures for the correct storage of vehicle contents.

c. The process for the reporting of extra damage and items that may have broken when removed or refitted.

The processes involved when handling batteries

a. The procedure for the removal, storage and refitting of lead acid batteries.
b. The procedure for the disposal of lead acid batteries.
c. Battery checks:
   i. electrolyte
   ii. discharge
   iii. specific gravity
d. The charging process and procedures:
   i. trickle charge
   ii. normal charge
   iii. boost / start
e. The health and safety issues involved when charging (explosive gasses).

Types of clips and fixings

a. The following types of clips and identify reasons and limitations for their use:
   i. speed
   ii. ‘c’
   iii. ‘d’
   iv. ‘j’ type captive nut
   v. ‘r’
   vi. ‘u’ type captive nut
   vii. cable clip
   viii. trim clips
b. The following types of fixings and identify reasons and limitations for their use:
   i. pop rivet
   ii. plastic rivet
   iii. plastic capture nut
   iv. nut and bolt
   v. soulder bolt

vi. 'Nyloc' type nuts
vii. washers
viii. 'Spring' type washers
ix. self tapping screws and bolts
x. quick release plastic trim fastenings
xi. trim tapes
xii. adhesives and sealers

The processes involved when carrying out quality checks

a. Items that may have been 'workshop' soiled and describe processes for rectifying:
   i. door cards
   ii. seats
   iii. carpets
   iv. boot and bonnet trims
b. Methods for checking gaps.
c. The process for checking and aligning headlamps:
   i. address handling procedures for halogen bulbs
   ii. address handling and health and safety issues relating to xenon bulbs and systems
d. Operational checks and rectification methods to include:
   i. lights
   ii. washers and wipers
   iii. SRS systems (checking not rectification)
   iv. charging system (checking not rectification)
   v. horn
   vi. fluid levels
   vii. interior switches
   viii. operation of door lock mechanisms

Removing and Fitting Non-Structural Body Panels

a. Find, interpret and use sources of information applicable to the removal and fitting of basic non welded non-structural body panels.
b. Select check and use all the tools and equipment required to remove and fit basic non welded non-structural body panels including:
   i. hinge pin removers
   ii. spanners
   iii. screwdrivers
c. The different types of mechanical fixings for non welded non-structural body panels and when and why they should be used including:
   i. bolts
   ii. self tapping bolts
   iii. speed nuts
   iv. washers
d. The correct procedures and processes for removing and fitting of non welded non-structural body panels.
e. The need for correct alignment of panels and methods to achieve this:
f. Aperture gaps
g. Alignment of panel features
h. Best fit of components to panels
i. Vehicle geometry
j. Operation of openings such as doors, tailgates, bonnets etc.
k. The types of quality control checks that can be used to ensure correct alignment and contour of panels and operation of components to manufacturer's specification.
l. The method of storing removed panels and the importance of storing them correctly.