



**education**

Department:  
Education  
REPUBLIC OF SOUTH AFRICA

# **NATIONAL CERTIFICATE (VOCATIONAL)**

## **SUBJECT GUIDELINES**

### **AUTOMOTIVE REPAIR AND MAINTENANCE**

#### **NQF Level 3**

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# **AUTOMOTIVE REPAIR AND MAINTENANCE – LEVEL 3**

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## INTRODUCTION

### **A. What is Automotive Repair and Maintenance?**

Automotive Repair and Maintenance introduces students to the fundamentals of vehicle technology and equips them with the necessary confidence to perform tasks related to, for example, vehicle components, engines, gearboxes, fuel systems, body components and electronics. The tasks are limited to removal, cleaning, servicing (replenishing of fluid) and fitting.

### **B. Why is Automotive Repair and Maintenance important in the Engineering and Related Design programme?**

With the necessary knowledge, students will be able to perform tasks and meet requirements set by the industries. Automotive Repair and Maintenance enables students to be more self-reliant and marketable. The subject allows the progression to further qualification and helps students understand terms used in manufacturing and assembly.

### **C. The link between the Automotive Repair and Maintenance Learning Outcomes and the Critical and Developmental Outcomes**

In Automotive Repair and Maintenance, students will identify faults and solve the problems relating to the automotive field. Students will have to work effectively individually or in teams. As students will need to record the requirements to fix faults, they will need communication and writing skills in Automotive Repair and Maintenance.

Automotive Repair and Maintenance also covers two of the Development Outcomes:

- Explore strategies to learn more effectively.
- Explore education and career opportunities.

### **D. Factors that contribute to achieving the Automotive Repair and Maintenance Learning Outcomes**

Students interested in Automotive Repair and Maintenance will benefit because it enables them to work on vehicle basics with related knowledge and use terminology for Automotive Repair and Maintenance correctly.

## 1 DURATION AND TUITION TIME

This is a one year instructional programme comprising 200 teaching and learning hours. The subject may be offered on a part-time basis provided all of the assessment requirements are adhered to.

Students with special education needs (LSEN) must be catered for in a way that addresses barriers to learning.

## 2 SUBJECT LEVEL FOCUS

- Removal, dismantling and installing of the main automotive components
- Checking and adjusting of steering geometry
- The fundamentals of mechanical fuel injection systems.
- Performing a basic condition test on a vehicle
- Services and repairs on conventional electrical systems
- Operation of petrol systems
- Operation of automotive carburettors

## 3 ASSESSMENT REQUIREMENTS

### 3.1 Internal assessment (50 percent)

#### 3.1.1 Theoretical component

The theoretical component will form 40 percent of the internal assessment. Theory will also be integrated into the practical component.

#### 3.1.2 Practical component

The practical component forms 60 percent of the internal assessment mark.

Practical components include applications and exercises. All practical components must be indicated in a Portfolio of Evidence (PoE).

Internal assessment of the practical component in Automotive Repair and Maintenance Level 3 takes the form of assignments, practical exercises, case studies and practical examinations in a workshop environment.

Students may complete practical exercises daily. Assignments and case studies can be completed at the end of a topic. Practical examinations can form part of internal practical assessment.

- **Some examples of practical assessment include, but are not limited to:**
  - Presentations (lectures, demonstrations, group discussions and activities, practical work, observations, role play, independent activity, synthesis and evaluation.
  - Exhibition by students
  - Visits undertaken by students based on a structured assignment task
  - Task performance simulated in a structured environment

- **Definition of the term “Structured Environment”**

“Structured environment” for the purposes of assessment refers to an actual or simulated workplace, or workshop environment.

Evidence of this practical component must be provided in the form of a Logbook with a clear listing of the competencies to be assessed. The following information must be contained in the logbook:

- Date of activity
- Task description
- Starting time
- Completing time
- Learner’s signature
- Supervisor’s signature

For the Logbook to be regarded as valid evidence it must be signed off by an officially assigned supervisor.

- **Evidence in practical assessments**

All evidence pertaining to evaluation of practical work must be reflected in the students’ PoE. The tools and instruments constructed and used for the purpose of conducting such assessments must be clear from evidence contained in the PoE.

### 3.1.3 Processing of internal assessment mark for the year

A year mark out of 100 is calculated by adding the marks of the theoretical component and the practical component of the internal continuous assessment.

### 3.1.4 Moderation of internal assessment mark

Internal assessment is subject to internal and external moderation procedures as set out in the *National Examinations policy for Further Education and Training College Programmes*.

## 3.2 External assessment (50 percent)

A national examination is conducted annually in October or November by means of a paper(s) set and moderated externally.

External assessment details are set out in the *Assessment Guidelines: Automotive Repair and Maintenance (Level 3)*.

## 4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUE
1. Removal of automotive main components	16%
2. Dismantling automotive main components	16%
3. Installing automotive main components	18%
4. Checking and adjusting of steering geometry	6%
5. The fundamentals of mechanical fuel injection systems	10%
6. Performing a basic condition test on a vehicle	8%
7. Services and repairs on conventional electrical systems.	10%
8. Operation of petrol systems	6%
9. Operation of automotive carburettors	10%
<b>TOTAL</b>	<b>100</b>

## 5 CALCULATION OF FINAL MARK

Continuous assessment: Student's mark/100 x 50/1 = a mark out of 50 (a)

Theoretical examination mark: Student's mark/100 x 50/1 = a mark out of 50 (b)

**Final mark: (a) + (b) = a mark out of 100**

All marks are systematically processed and accurately recorded to be available as hard copy evidence for, amongst others, purpose of moderation and verification, as well as purposes of reporting.

## 6 PASS REQUIREMENT

The student must obtain at least fifty (50) percent in ICASS and fifty (50) percent in the examination.

## 7 SUBJECT AND LEARNING OUTCOMES

On completion of Automotive Repair and Maintenance Level 3 the student should have covered the following topics:

- Topic 1: Removal of automotive main components
- Topic 2: Dismantling of automotive main components
- Topic 3: Installing of automotive main components
- Topic 4: Checking and adjusting of steering geometry
- Topic 5: The fundamentals of mechanical fuel injection systems.
- Topic 6: Performing a basic condition test on a vehicle
- Topic 7: Services and repairs on conventional ignition systems
- Topic 8: Operation of petrol fuel systems
- Topic 9: Operation of automotive carburettors

### 7.1 Topic 1 Removal of automotive main components

**7.1.1 Subject Outcome 1:** Explain and perform cleaning procedures of automotive components.

#### Learning Outcomes:

- Describe proper cleaning procedures for automotive components.
- Explain the functioning and operation of the cleaning equipment.
- Clean components for inspection.

**7.1.2 Subject Outcome 2:** Assess components according to specifications.

#### Learning Outcomes:

- Identify different parts/components.
- Explain the function of different parts/components.
- Measure and record cylinder blocks and heads.
- Measure and record piston and connecting rod assemblies.
- Measure and record camshaft.
- Inspect gear chain and timing.
- Measure and record crankshaft and bearings.

**7.1.3 Subject Outcome 3:** Determine the serviceability of parts and components.

#### Learning Outcomes:

- Obtain technical data on components from the appropriate manual.
- Describe procedures to assess parts.

**7.1.4 Subject Outcome 4:** Compile and submit a condition report on services required (a “before service” report).

**Learning Outcomes:**

- Interpret findings on serviceability of parts and components.
- Record and submit necessary information on services required.

**7.1.5 Subject Outcome 5:** Identify and select correct tools and equipment for removing automotive components.

**Learning Outcomes:**

- Explain and demonstrate the correct use and care for tools and equipment related to the removing of components.
- Obtain instructions for relevant service information and procedures from various sources.
- Select and care for workshop equipment applicable to the task.
- Select and care for hand tools applicable to the task.

**7.1.6 Subject Outcome 6:** Remove automotive components

*Range: ISO 9000.*

**Learning Outcomes:**

- Select and name components and component parts.
- Remove components in the correct order using appropriate quality procedures and correct tools.
- Adhere to safety procedures while removing components.
- Identify ferrous and non-ferrous metals of the components.
- Restore the work area to a serviceable condition.

**7.1.7 Subject Outcome 7:** Complete documentation on removal of components (an “after service” report).

**Learning Outcomes:**

- List and number components removed in correct sequence.
- Record details of work required on components.
- Identify and record additional faults.
- Communicate information to the workshop manager/facilitator.
- Complete and process documents.

## **7.2 Topic 2 Dismantling automotive main components**

**7.2.1 Subject Outcome 1:** Explain dismantling procedures according to a specific manufacturer’s manual.

**Learning Outcomes:**

- Identify tools and equipment needed for dismantling from appropriate manual.
- Describe correct preparation of the work area for dismantling.
- Explain procedures for dismantling and storage of components.
- Explain safety procedures to follow during dismantling and storage of components.

**7.2.2 Subject Outcome 2:** Dismantle components using appropriate tools, equipment and procedures.

**Learning Outcomes**

- Identify and select appropriate tools and equipment for dismantling.
- Prepare the work area for dismantling of components.
- Correctly dismantle components and number components to be stored.
- Explain component repair procedures.
- Adhere to safety procedures while dismantling components.

### **7.2.3 Subject Outcome 3:** Repair relevant parts/components.

#### **Learning Outcomes:**

- Identify condition of components and decide on work to be done.  
*Range: Welding, engineering, testing and machining.*
- Follow manufacturer's specifications and procedures during repairs.
- Check and test components after completion of repairs.
- Store components in a designated area.

## **7.3 Topic 3 Installing automotive main components**

### **7.3.1 Subject Outcome 1:** Explain and verify serviceability of components.

*Range: Cylinder head, cylinder block, crank shaft, camshaft, piston and conrods, also all other components enabling interactions of main components.*

#### **Learning Outcomes:**

- Identify parts/components that need to be prepared prior to assembly.
- Inspect the condition of components.
- Explain component repairs and required procedures according to manufacturer's or engineering specifications.
- Send relevant parts for engineering or machining work to be completed.
- Receive relevant parts/components back from engineering and machining for assembly.
- Explain and complete component checking and testing.

### **7.3.2 Subject Outcome 2:** Source reconditioned and/or replacement parts/components.

*Range: Cylinder head, cylinder block, crank shaft, camshaft, piston and conrods, also all other components enabling interactions of main components*

#### **Learning Outcomes:**

- Obtain measurement of components as prescribed by engineering or manufacturer's specifications.
- Obtain additional parts/components needed for assembling.

### **7.3.3 Subject Outcome 3:** Assemble according to manufacturers specifications/procedures.

#### **Learning Outcomes:**

- Determine specifications and procedures on assembling of required components according to the appropriate manual.
- Determine the correct placement of components.
- Carefully assemble combined components to prevent faulty procedures.
- Complete final checking on all specifications after assembling.

## **7.4 Topic 4 Checking and adjusting of steering geometry**

### **7.4.1 Subject Outcome 1:** Plan and prepare for checking and adjusting of steering geometry.

#### **Learning Outcomes:**

- Determine specifications and equipment required to complete repairs and assembling according to the appropriate manual.
- Explain the concept of run flat tires.
- Describe road safety aspects concerning lifting of vehicles
- Explain lifting procedures, wheel removal and refitting of a wheel
- Explain the pre-checks to perform for removal and fitting of a wheel
- Differentiate between safe and unsafe positioning of a vehicle

**7.4.2 Subject Outcome 2:** Explain and perform checks on other components relating to checking and adjusting steering geometry.

**Learning Outcomes:**

- Observe and record unusual tire wear patterns.
- Check and adjust tyre air pressure.
- Diagnose wheel and tyre vibration problems and repair it.
- Check nut torque settings according to factory recommendations and adjust if necessary.
- Perform a wheel and tyre assembly balance.

**7.4.3 Subject Outcome 3: Perform pre-checks and analyse information.**

**Learning Outcomes:**

- Disable Supplemental Restraint Systems (SRS) to prevent possible activation during adjustment on steering geometry.
- Diagnose steering column noises and binding problems.
- Diagnose manual steering gear and adjustment.
- Diagnose manual rack and pinion steering gear and adjustment.
- Apply quality procedures while checking and adjusting steering geometry.
- Apply safety procedures while checking and adjusting steering geometry.  
*Range: Work habits, Material Safety Data Sheets (MSDS), Environmental Protection Agency (EPA) Regulations, Occupational Safety Health Administration (OSHA) regulations, Fire extinguishers and .*

**7.4.4 Subject Outcome 4:** Explain and perform wheel alignment and adjustment.

**Learning Outcomes:**

- Explain wheel alignment theory.
- Explain and perform vehicle steering problem diagnosis and repairs.
- Explain and perform checking of caster and camber angles to determine possible adjustments.
- Explain and perform checking of toe in and toe out to determine possible adjustments.
- Explain and perform steering axis inclination (SAI) and King Pin Inclination (KPI) checking and repairs.

## **7.5 Topic 5 The fundamentals of mechanical fuel injection systems**

**7.5.1 Subject Outcome 1:** Explain the basic functions of the diesel fuel system.

**Learning Outcomes:**

- Determine specifications and procedures on mechanical fuel injection systems according to the appropriate manual.  
*Range: Timing marks and operating pressures.*
- Identify components of a basic fuel injection system.
- Explain the functions of components.
- Select crucial parts/components which need special attention during inspection of fuel injection systems. and indicate the importance of these parts.
- Explain checking and testing of components.
- Identify special tools for testing or working on a fuel injection system.

**7.5.2 Subject Outcome 2:** Describe diesel fuel classifications.

**Learning Outcomes:**

- Describe different diesel fuel grades used in industry.
- Describe different fuel additives.
- Explain diesel ignition abilities.

### **7.5.3 Subject Outcome 3:** Explain the importance and uses of different fuel filters and systems.

#### **Learning Outcomes:**

- Identify different fuel replacement filters  
*Range: In-Line Fuel Filters, In-Carburetor Fuel Filters, Fuel-Injector Filters.*
- Identify different materials used for outer casings.
- Explain different pressures in fuel systems.
- Describe the different uses of fuel filters.
- Explain the importance of service intervals on fuel filters.
- Identify different fuel systems in small medium and heavy duty vehicles.  
*Range: Caterpillar Fuel Systems, Detroit Fuel Systems, Cummins Fuel Systems, Stan dyne Fuel Systems, Bosch Systems.*

## **7.6 Topic 6 Performing a basic condition test on a vehicle**

### **7.6.1 Subject Outcome 1:** Describe basic condition test procedures.

#### **Learning Outcomes:**

- Describe various retardation systems.  
*Range: all human and vehicle requirements according to roadworthy specifications.*
- Describe criteria to use when performing a condition test.  
*Range: inside criteria, outside criteria, bumper to bumper.*
- Describe test procedures to use when performing a vehicle condition test.  
*Range: bumper to bumper*

### **7.6.2 Subject Outcome 2:** Use test equipment to perform assessment of components.

#### **Learning Outcomes:**

- Clean components for inspection.
- Use test equipment and asses various retardation system.  
*Range: disc brakes, drum brakes, hydraulic and air brake systems*
- Use test equipment and perform a vehicle condition test.  
*Range: Inside criteria, outside criteria, bumper to bumper.*

### **7.6.3 Subject Outcome 3:** Compare outcomes of assessment with manufacturer's specifications.

#### **Learning Outcomes:**

- Choose comparison procedures to follow and motivate the decision.
- Select suitable test criteria to compare the outcomes.
- Explain findings/results of assessment according to selected criteria.
- Interpret findings/results of conditions after comparison.
- Make a judgement call on the overall condition of the vehicle.

### **7.6.4 Subject Outcome 4:** Compile and submit a condition report.

#### **Learning Outcomes:**

- Describe report writing and submission procedures.
- Write an accurate condition report including all technical specifications.
- Submit the report to the workshop manager/facilitator.

## **7.7 Topic 7 Services and repairs on conventional electrical systems**

### **7.7.1 Subject Outcome 1:** Explain and illustrate basic electrical theories and components.

*Range: Battery, ignition switch, high voltage coil, ballast resistor, condenser*

#### **Learning Outcomes:**

- Explain basic electrical safety aspects.
- Explain and draw ignition wiring and circuit diagrams.
- Explain the working of an automotive battery.
- Perform a battery diagnosis and service.
- Describe basic electrical troubleshooting and service.

### **7.7.2 Subject Outcome 2:** Explain and use electrical and electronic components.

#### **Learning Outcomes:**

- Describe the inspection and testing of electronic and electrical components.  
*Range: Direct current starting system, charging system.*
- Explain how to service electrical components.  
*Range: Direct current starting system, charging system.*
- Perform a complete service on electrical components.  
*Range: Direct current starting system, charging system.*

### **7.7.3 Subject Outcome 3:** Describe and repair electrical circuit problems.

*Range: Lighting circuit, cluster and instrumentation.*

#### **Learning Outcomes:**

- Describe and perform inspection on lighting circuits.
- Describe and perform minor repairs on lighting circuits.
- Inspect and repair different cluster instrumentations.  
*Range: Conventional Analogy Instrumentation, Indicator Lights, and Warning Devices*

## **7.8 Topic 8 Operation of petrol systems**

### **7.8.1 Subject Outcome 1:** Explain petrol as an automotive fuel.

#### **Learning Outcomes:**

- Differentiate the types and grades of petrol available on the market.
- Describe different additives used in petrol currently.
- Explain the theory of air and fuel mixture to form a gas.
- Describe and use a model to demonstrate petrol combustion processes.
- Identify different components on the Electronic Fuel Injection (EFI) system.
- Describe the functions and operations of all Electronic Fuel Injection (EFI) components.
- Explain safety procedures to use when working on Electronic Fuel Injection (EFI) components.

## **7.9 Topic 9 Operation of automotive carburetors**

### **7.9.1 Subject Outcome 1:** Explain the operation of automotive carburetors.

#### **Learning Outcomes:**

- Differentiate between single and twin choke carburetors.
- Explain the operation of single and twin choke carburetors.
- Explain different carburetor circuits used at different throttle positions.
- Describe different choke mechanisms.
- Describe the use of a hand vacuum pump.
- Explain mixture adjustments to improve emission levels.
- List typical carburetor faults and provide possible solutions.

### **7.9.2 Subject Outcome 2:** Perform selected tasks on automotive carburetors.

#### **Learning Outcomes:**

- Use a model to demonstrate different carburetor circuits at different throttle positions.
- Complete a gas analysis test.
- Use a hand vacuum pump to check vacuum controls.
- Complete a basic carburetor service check.
- Complete a faultfinding check on different carburetors and provide possible solutions for repairs.

## 8 RESOURCE NEEDS FOR THE TEACHING OF AUTOMOTIVE REPAIR & MAINTENANCE - LEVEL 3

### 8.1 Physical resources

The following teaching aids should be made available, if possible:

- **Practicum room:**
  - A simulated workshop environment, provided with the basic tools and workshop equipment.
  - Necessary electronic equipment, e.g. training models, timing, television, with video or DVD to play, filing cabinet, computer, printer
  - The latest developments in electronic equipment must be available
  - The computer must be provided with internet connection to enable the facilitator to demonstrate website browsing for research purposes.
- **Technology and Research Centre:**
  - Availability of computers and printers for students to complete assignments/case studies and do research
  - Access to internet for students
  - Research software, e.g. Encarta, etc
  - Subject related magazines (e.g. Motor Vehicle technology; Auto data book and Technique, etc.), news paper that are related to the subject and subject related reference books for research by students
  - Subject related DVDs/Videos
  - List of stakeholders prepared to be involved in the learning process through presentations or acting as guest speakers or providing the opportunity for students to gain practical experience.
  - Applicable legislation / Acts for use by lecturers during lessons and students for research purposes
  - Stock room to store video/DVD machines, televisions, etc
  - Security for stockroom, media centre and practicum room.
- **Class room:**
  - Computer and data projector or latest technology to electronically project data for students, must be available for facilitator
  - Flash disk for facilitator to store information
  - Presentation program on computer to be used by facilitator to provide students with visual information on Learning Outcomes.
  - White board, black board and pull down screen
  - Desks for students big enough to work on. Students are going to use many resources e.g. newspapers, documents, etc to work from.

### 8.2 Human resources

- **Lecturer / facilitator:**
  - Applicable subject related qualification on NQF Level 5
  - It will be to the advantage of facilitators/lecturers if they have declared competence as assessors and/or moderators
  - Training in OBE

Full time **technology and research centre manager** (with knowledge of computers, website browsing, research and reference books)

### 8.3 Other Resources

- Text books
- Answer books, with examples which students must complete for practical assignments
- Calculator for each student.
- Lever arch file for each student to serve as PoE
- Lever arch file for Practical Assessment Portfolio.