



**education**

Department:  
Education  
REPUBLIC OF SOUTH AFRICA

# **NATIONAL CERTIFICATE (VOCATIONAL)**

## **SUBJECT GUIDELINES**

### **AUTOMOTIVE REPAIR AND MAINTENANCE**

#### **NQF Level 4**

September 2007



# **AUTOMOTIVE REPAIR AND MAINTENANCE – LEVEL 4**

## **CONTENTS**

### **INTRODUCTION**

#### **1 DURATION AND TUITION TIME**

#### **2 SUBJECT LEVEL FOCUS**

#### **3 ASSESSMENT REQUIREMENTS**

3.1 Internal assessment

3.2 External assessment

#### **4 WEIGHTED VALUES OF TOPICS**

#### **5 CALCULATION OF FINAL MARK**

#### **6 PASS REQUIREMENT**

#### **7 SUBJECT AND LEARNING OUTCOMES**

7.1 Test, diagnose, and rectify faults in an electronic fuel injection (EFI) system on an engine

7.2 Diagnose and repair faults in induction and exhaust systems

7.3 Diagnose and repair hydraulic brake systems

7.4 Diagnose and repair cooling systems

7.5 Repair manual transmissions

7.6 Repair suspension systems

7.7 Diagnose and repair steering systems components

7.8 Service and repair automobile electronic ignition systems

7.9 Repair vehicle differentials

7.10 Recondition vehicle sub assembly

7.11 Test automatic transmission

#### **8 RESOURCE NEEDS FOR THE TEACHING OF AUTOMOTIVE REPAIR AND MAINTENANCE - LEVEL 4**

8.1 Physical resources

8.2 Human resources

8.3 Other resources

## 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 Learning Outcomes for Automotive Repair and Maintenance and the Critical and Developmental Outcomes**

In Automotive Repair and Maintenance, students will identify faults and solve 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

Carry out special vehicle maintenance and repair.

*Range: Special vehicle maintenance includes: automotive transmission, fuel injection, computer electronic system, body construction*

- The characteristics of specialised automotive systems are identified and explained in terms of their properties and function.
- Common problem occurring with the system are identified in terms of how they manifest.
- Solutions to the problems are identified and addressed according to manufacturer's specifications.
- Work is conducted in accordance with workplace safety requirements and current legislation.

## 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 4 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
- Student'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 student's PoE. The tools and instruments used for the purpose of conducting such assessments must be part of the 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 4)*.

## 4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUE
1. Test, diagnose, and rectify faults in an electronic fuel injection (EFI) system on an engine.	12%
2. Diagnose and repair faults in induction and exhaust systems.	10%
3. Diagnose and repair hydraulic brake systems	10%
4. Diagnose and repair cooling systems.	8%
5. Repair manual transmissions.	6%
6. Repair suspension systems	10%
7. Diagnose and repair steering systems components	8%
8. Service and repair automobile electronic ignition systems.	10%
9. Repair vehicle differentials.	6%
10. Recondition vehicle sub assembly	10%
11. Test automatic transmission	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 percent (50) in the examination.

## 7 SUBJECT AND LEARNING OUTCOMES

On completion of Automotive Repair and Maintenance Level 4 the student should have covered the following topics:

Topic 1:	Test, diagnose, and rectify faults in an electronic fuel injection (EFI) system on an engine.
Topic 2:	Diagnose and repair faults in induction and exhaust systems.
Topic 3:	Diagnose and repair hydraulic brake systems
Topic 4:	Diagnose and repair cooling systems.
Topic 5:	Repair manual transmissions.
Topic 6:	Repair suspension systems
Topic 7:	Diagnose and repair steering systems components
Topic 8:	Service and repair automobile electronic ignition systems.
Topic 9:	Repair vehicle differentials.
Topic 10:	Recondition vehicle sub assembly
Topic 11:	Test automatic transmission

### 7.1 Topic 1: Test, diagnose, and rectify faults in an electronic fuel injection (EFI) system on an engine

#### 7.1.1 Subject Outcome 1: Test and diagnose faults in an EFI system on an engine.

##### Learning Outcomes:

- Observe safe working practices throughout the task.
- Check the fuel system and the engine compartment visually to ensure no obvious faults exist.
- Select and use suitable equipment to enable system tests to be completed.
- Use test instruments without causing damage to circuit components and electronic devices.
- Activate, read and interpret the self-test codes and identify any circuit that has a fault.
- Test the circuit indicated by the self-test codes and locate and identify the fault.
- Test the EFI circuits not monitored by the self-test system, and identify and locate any faults.
- Check the air intake system for blockages and leaks and determine if it is operating correctly.
- Test the fuel supply system for operating pressure, pressure retention, and fuel flow rate, and record the results.
- Measure the exhaust emissions and engine speed at normal operating temperature, and the record the results
- Record and compare the results of the above tests with the vehicle specification, and analyse to locate and identify the cause of any fault.

#### 7.1.2 Subject Outcome 2: Test and service the EFI fuel injectors.

##### Learning Outcomes:

- Observe safe working practices throughout the task.
- Select and use suitable tools and equipment to enable tests and service work to be carried out.
- Test the injectors and determine which are unserviceable and the nature of unserviceability.
- Clean the injectors to restore normal operation by running the engine on a chemical cleaning fuel.
- Replace reject injectors and injector seals with new ones that meet manufacturer's specification.

#### 7.1.3 Subject Outcome 3: Rectify EFI system faults on an engine.

##### Learning Outcomes:

- Observe safe working practices throughout the task.
- Replace any faulty EFI system components with parts that meet manufacturer's specifications, and in a manner prescribed by the manufacturer.
- Test the system to ensure the integrity of the wiring is maintained in a serviceable condition.
- Test the system to ensure there are no fuel blockages.
- Test the system to ensure that there are no air or fuel leaks.

- Check all adjustments and where necessary, correct to comply with manufacturer's specifications.
- Operate and perform the EFI system to manufacturer's specifications.

## **7.2 Topic 2: Diagnose and repair faults in induction and exhaust systems**

### **7.2.1 Subject Outcome 1: Check fuel system**

#### **Learning Outcomes:**

- Check fuel level and quality; determine needed action.  
*Range: Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, and supply and return lines and fittings; determine needed action.*

### **7.2.2 Subject Outcome 2: Inspect the fuel pump.**

#### **Learning Outcomes:**

- Inspect, clean, and test fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, ECM cooling plates, and mounting hardware; determine and record needed action.
- Inspect and test low pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings); determine needed action.
- Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump.
- Inspect and test power and ground circuits and connections; determine and record needed action.

### **7.2.3 Subject Outcome 3: Inspect and replace electronic system**

#### **Learning Outcomes:**

- Locate and use relevant service information  
*Range: To include diagnostic procedures, flow charts, and wiring diagrams).*
- Inspect and replace electrical connector terminals, seals, and locks.
- Inspect and test sensors, controls, actuator components, and circuits; adjust or replace as needed.
- Access and change customer parameters, using recommended electronic diagnostic tools.  
*Range: To include PC based software and/or data scan tools), access and change customer parameters.*
- Perform cylinder contribution test utilising recommended electronic diagnostic tool.

## **7.3 Topic 3: Diagnose and repair hydraulic brake systems**

### **7.3.1 Subject Outcome 1: Demonstrate diesel technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements for a diesel repair facility.**

#### **Learning Outcomes:**

- Determine the safe and correct application for chemicals used in a diesel repair facility.
- Use protective clothing and safety equipment.
- Use fire protection equipment.
- Follow OSHA and EPA regulations affecting diesel service technology.
- Respond to safety communications.

### **7.3.3 Subject Outcome 3: Apply fundamental science concepts to truck brake technology.**

#### **Learning Outcomes:**

- Examine how physics concepts apply to brake system operation.
- Explore the application of fundamental laws of hydraulics to brake hydraulic systems.
- Analyse the characteristics and properties of liquids as applied to brake fluid.

### 7.3.4 Subject Outcome 4: Properly test, diagnose, and repair air brake air supply and service systems.

#### Learning Outcomes:

- Analyse the function and operation of air supply and service systems.
- Test, diagnose, and repair or replace air supply and service systems and components.
- Examine and record the effects of weight and speed on braking and stopping distance.
- Research and explain thermal expansion of fluids, gases, and solids.
- Explain the principles of thermodynamics with respect to braking.
- Determine which concepts of force, mass, and acceleration apply to braking, considering Newton's laws of motion.
- Illustrate how motion converts to heat energy.
- Explain how atmospheric pressure relates to the term vacuum.
- Assess and record the characteristics of liquids.
- Determine and explain the properties of brake fluid.
- Discuss and record the laws of hydraulics as applied to brakes systems.

### 7.3.5 Subject Outcome 5: Properly test, diagnose, and repair air brake mechanical/foundation brakes.

#### Learning Outcomes:

- Analyse the function and operation of air brake mechanical/foundation brakes.
- Test, diagnose, and repair or replace air brake mechanical/foundation brakes and components.
- Examine and observe the air brake system requirements of the FMVSS (Federal Motor Vehicle Safety Standard) 121 requirements.
- Illustrate the operation of the following and determine needed action.

*Range: Air brake supply system, air brake system governor and compressor, air brake control system, check valves, malfunctions.*

- Check air system build-up time and determine needed action.
- Drain air reservoir tanks; check for oil, water, and foreign material and determine needed action.
- Inspect, adjust, and align compressor drive belts, pulleys, and tensioners; low pressure warning devices, and components that remove water from the air brake system.
- Diagnose and replace where needed poor stopping, air leaks, premature wear, pulling, grabbing, or dragging problems caused by supply and service system.
- Inspect/test the following and adjust, repair, or replace as needed.

*Range: Compressor drive gear and coupling; air compressor, air cleaner/supply, oil supply and coolant lines, fittings, and mounting brackets; systems pressure controls: governor, unloader assembly valves, intake screens, filters, lines, hoses, and fittings; air system lines, hoses, fittings, and couplings; air tank relief (safety) valves, one-way (single) check valves, two-way (double) check-valves, manual and automatic drain valves; air drier systems, filters, valves, heaters, wiring, and connectors; brake application (foot) valve, fittings, and mount; stop light circuit switches, wiring, and connectors; hand brake (trailer) control valve, lines, fittings, and mountings; brake relay valve.; quick release valves; front and rear axle limiting (proportioning) valves; tractor protection valve.*

- Illustrate and record the operation of the following:  
*Range: Air brake mechanical/foundation brakes and components; S-Cam type foundation brake assemblies; Wedge type foundation brake assemblies, including their self-adjusting mechanisms.*
- Compare and explain the design and operation of the different types of automatic slack adjusters.
- Diagnose and determine needed action for poor stopping, brake noise, premature wear, pulling, grabbing, or dragging problems caused by the foundation brake, slack adjuster, and brake chamber problems.
- Inspect, test, repair or replace the following as needed:

*Range: Service brake chambers, diaphragm, clamp, spring, pushrod, clevis, and mounting brackets; Camshafts, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor spins, and springs; Wedge brake spider, manual and automatic adjuster plungers, housing, and wedge assembly.*

- Inspect, service and perform needed action for manual and automatic slack adjusters.
- Inspect, clean, adjust and determine needed repairs for air disc brake calliper assemblies.
- Inspect, measure and perform needed action on the following :

*Range: Brake shoes; linings; pads; drums; rotors.*

## **7.4 Topic 4: Diagnose and repair cooling systems**

### **7.4.1 Subject Outcome 1: Check and test engine coolant.**

#### **Learning Outcomes:**

- Check engine coolant level, condition, and consumption; determine needed action.
- Bleed cooling system and recover, flush, and refill with recommended coolant/additive package.
- Test and adjust coolant for freeze protection and additive package concentration.

### **7.4.2 Subject Outcome 2: Adjusting of belt.**

#### **Learning Outcome:**

- Inspect, replace and adjust drive belts, tensioners, and pulleys.

### **7.4.3 Subject Outcome 3: Inspecting of engine component coolant.**

#### **Learning Outcomes:**

- Inspect and replace coolant conditioner/filter assembly for leaks; valves, lines, and fittings.
- Inspect and replace water pump and hoses as needed.
- Inspect, clean, and pressure test radiator, pressure cap, tank(s), and recovery systems; determine needed action.

## **7.5 Topic 5: Repair manual transmissions**

### **7.5.1 Subject Outcome 1: Manual transmission types and applications.**

#### **Learning Outcomes:**

- Identify and describe clutch system components and their operation.
- Service, replace and adjust clutches.
- Identify manual transmission components and describe their operation.
- Trace manual transmission power flow.
- Service, adjust and repair manual transmissions.
- Solve automotive problems in a systematic, logical, and efficient manner.
- Diagnose and repair driveability problems on early and current car models, including those with fuel injection and computerized engine controls.
- Diagnose and repair simple and complex electrical problems.
- Diagnose and repair engine mechanical problems.
- Diagnose and repair automatic transmissions and transaxles, including total rebuilding of units.

### **7.5.2 Subject Outcome 2: Service gears, shafts and synchronizing.**

#### **Learning Outcomes:**

- Identify safety devices.
- Identify drive shaft and universal components and describe their operation.
- Service and repair drive shaft, CV, and universal type joints.
- Identify rear axle components and describe their operation.
- Service, adjust and repair rear axles.
- Diagnose and repair manual transmissions and transaxles, as well as other driveline components such as drive-shafts, drive axles, and differentials.
- Measure engine and other automotive parts, using the appropriate measuring instruments.

### 7.5.3 Subject Outcome 3: Overhaul, repairs and adjustments.

#### Learning Outcomes:

- Identify transaxle components and describe their operation.
- Service, adjust, and repair transaxles.
- Diagnose clutch, transmission, drive line and rear axle problems.
- Understand machining and repair of drive line components.
- Diagnose and repair steering and suspension problems and properly align the suspension of all types of automobiles and light trucks, using either two- or four-wheel alignment machines.
- Diagnose and repair automotive air-conditioning systems.
- Demonstrate an understanding of basic principles needed for understanding of new technologies as they become incorporated into automobile designs.
- Make repair estimates and complete the necessary paperwork for customer service and warranty repairs.
- Apply basic business practices, including cultivation of good customer and employee relations.

## 7.6 Topic 6: Repair suspension systems

### 7.6.1 Subject Outcome 1: Diagnose and repair various front suspension system problems using a strategy-based process.

#### Learning Outcomes:

- Determine root cause for front suspension problems related to the following:  
*Range: Ride height, body sway, McPherson strut, SLA components, linkages, knuckle assemblies, ball joints, and bearing plated assemblies.*
- Perform needed repairs to solve front system problems related to the following:  
*Range: Ride height, body sway, McPherson strut, SLA components, linkages, knuckle assemblies, ball joints, and bearing plated assemblies.*

### 7.6.2 Subject Outcome 2: Diagnose and repair various rear suspension system problems using a strategy-based process.

#### Learning Outcomes:

- Diagnose and determine root cause for the following:  
*Range: Steering system problems related to steering columns, linkages, gearbox, rack, power steering components and electronically controlled systems.*
- Repair front system problems related to:  
*Range: Ride height, body sway, McPherson strut, SLA components, linkages, knuckle assemblies, ball joints, and bearing plated assemblies.*

### 7.6.3 Subject Outcome 3: Diagnose wheel alignment problems and perform needed adjustments or repair.

#### Learning Outcomes:

- Determine root cause of alignment problems related to vehicle stability and handling, tyre wear, and steering wheel location.
- Perform pre-alignment inspection procedures according to MFG recommendations.
- Perform two and four wheel alignment inspection and adjust front and rear wheel as needed.
- Perform front cradle alignment procedure.

### 7.6.4 Subject Outcome 4: Diagnose and repair various wheel and tyre problems.

#### Learning Outcomes:

- Determine root cause of unusual tyre problems related to wear patterns, vibration, shimmy, noise and vehicle pull.
- Perform needed repairs to solve tyre related problems.
- Perform proper preventative service on tyre and wheel components

## **7.7 Topic 7: Diagnose and repair steering systems components**

### **7.7.1 Subject Outcome 1: Apply proper safety procedures and processes.**

#### **Learning Outcomes:**

- Explain shop environment and describe hazards.
- Observe and describe emergency procedures and policy.
- Accept responsibility for personal well being and practice and follow safety guidelines.
- Observe and explain material safety data sheets and chemicals used in shop.

### **7.7.2 Subject Outcome 2: Diagnose and repair various steering system problems using a strategy-based process.**

#### **Learning Outcomes:**

- Determine root cause for the following problems:  
*Range: Steering systems' problems related to steering columns, linkages, gearbox, rack, power steering components and electronically controlled systems.*
- Perform needed repairs to the following:  
*Range: Solve steering systems' problems related to steering columns, linkages, gearbox, rack, power steering components and electronically controlled systems.*

## **7.8 Topic 8: Service and repair automobile electronic ignition systems**

### **7.8.1 Subject Outcome 1: Diagnose, service and maintain automobile air conditioning systems.**

#### **Learning Outcomes:**

- Discuss and explain the basic operating principles of the refrigeration cycle and the function of air-conditioning components of an automobile air-conditioning system.
- Read and interpret air-conditioning electrical circuit diagrams and component symbols.
- Maintain automobile air-conditioning systems.
- Service an automobile air-conditioning system.
- Remove and fit automobile air conditioner components.
- Diagnose automobile air conditioning problems.
- Apply relevant safety practices when working with air conditioning systems.
- Discuss and report incidents and problems related to automobile air conditioning systems and compile fault finding reports and requisition forms.
- Identify and select appropriate tools, test equipment and components.
- Test and repair without causing any damage and in a safe manner.
- Check to see if air conditioning system is operating according to manufacturers specifications
- Service air conditioning system according to manufacturer's specifications

### **7.8.2 Subject Outcome 2: Construct and test advanced electronic circuits.**

#### **Learning Outcomes:**

- Discuss and explain the fundamentals of advanced electronics.
- Discuss and explain the operation of advanced electronic circuits.
- Read and interpret advanced electronic circuit diagrams.
- Identify and select advanced electronic and related components for circuit construction.
- Test advanced electronic circuits for static and dynamic voltages.
- Construct advanced electronic circuits.
- Apply the relevant safety procedures when working with electronic equipment.
- Discuss and report incidents and problems related to advanced electronic work and compile fault finding reports and requisition forms.
- Select and use appropriate tools, personal and automobile protective equipment correctly.
- Identify and use appropriate hand tools and test equipment correctly.
- Locate and repair faults.
- Operate circuit according to manufacturers' specifications.

### **7.8.3 Subject Outcome 3: Trace and repair faults on advanced auto-electrical circuits.**

#### **Learning Outcomes:**

- Read, discuss and interpret automobile electric circuit diagrams and symbols.
- Select and use test equipment to locate faults on auto electric circuits following prescribed fault finding techniques using manuals and circuit diagrams.
- Remove faulty and refit new auto electrical components from/to an automobile.
- Complete fault reports and requisition forms.

### **7.8.4 Subject Outcome 4: Diagnose, test and repair electronic automobile fuel injection systems.**

#### **Learning Outcomes:**

- Discuss and explain the operation of an electronic fuel injection system.
- Read and interpret block diagrams of an electronic fuel injection system.
- Identify and select electronic fuel injection system and sub-system components.
- Locate faults on an electronic fuel injection system.
- Service electronic fuel injection systems.
- Apply the relevant system safety and servicing precautions when working with electronic fuel injector systems.
- Discuss and report incidents and problems related electronic fuel injector systems and complete fault finding reports and requisitions.
- Select and use tools, test equipment and components are correctly.
- Remove and fit electronic ignition system components are correctly.
- Test and repair automobile electronic ignition system according to manufacturers' specifications.
- Diagnose electronic ignition system faults are correctly.
- Complete relevant documentation is used and correctly.
- Adhere to working practices in a safe manner.
- Respond to questions and discuss issues related to automobile electronic ignition systems.

### **7.8.5 Subject Outcome 5: Fit and wire up auxiliary auto-electrical equipment.**

#### **Learning Outcomes:**

- Discuss and explain the operation of auxiliary auto-electrical equipment and related harnesses fitted to an automobile
- Plan and prepare for fitting and wiring of auxiliary auto-electrical equipment.
- Fit and wire auxiliary auto-electrical equipment.
- Commission and test fitted auxiliary auto-electrical equipment.
- Complete necessary documentation/reports.
- Apply relevant safety practices when fitting and wiring auxiliary auto-electrical equipment.
- Select and use tools, test equipment and components correctly.
- Remove, check and refit electronic fuel injection system components.
- Test and repair automobile electronic fuel injection system according to manufacturer's specifications.
- Diagnose electronic fuel injection system faults correctly.
- Use and complete relevant documentation correctly.
- Adhere to safe working practices.
- Can respond to questions and discuss issues related to automobile electronic fuel injection systems.

### **7.8.6 Subject Outcome 6: Service and repair electronic automobile ignition systems.**

#### **Learning Outcomes:**

- Read and interpret automobile electronic ignition system circuit diagrams and symbols.
- Select, explain and discuss various components used in automobile electronic ignition systems.
- Remove and fit ignition system components from/to an automobile using the correct tools in a safe and aware manner according to procedures.
- Service and test electronic ignition system and components.
- Diagnose electronic ignition system problems.
- Complete fault reports and requisition forms.

## **7.9 Topic 9: Repair vehicle differentials**

### **7.9.1 Subject Outcome 1: Identify and select correct tools and equipment.**

#### **Learning Outcomes:**

- Use and care for appropriate tools and equipment.
- Explain the method to recondition differentials.
- Use and care for measuring instruments related to differential reconditioning.
- Observe and explain procedures to test and check differentials prior to dismantling and after reconditioning.
- Read and interpret job instructions and determine a sequence of operations according to work site procedures.
- Identify and select appropriate tools and equipment and select according to job requirements and work site procedures.
- Acquire manufacturers' manuals and/or specifications according to job requirements.
- Identify and select appropriate personal protective equipment (PPE) according to statutory requirements.
- Prepare work area and differential according to safety, work site and manufacturers' procedures.
- Give reasons for selecting appropriate tools, equipment and PPE.
- Give reasons for preparing work area and differential.
- Explain the purpose of acquiring documentation and manuals.

### **7.9.2 Subject Outcome 2: Assess differential.**

#### **Learning Outcomes:**

- Discuss the operation of a differential.
- Identify, name and explain the functions of differential parts.
- Identify ferrous and non-ferrous metals related to differentials.
- Explain the methods of assessing serviceability of differential parts.
- Clean parts, before assessment, according to manufacturer's, work site and safety procedures.
- Inspect parts visually for defects according to manufacturer's guidelines.
- Measure parts according to manufacturer's procedures.
- Use measuring equipment according to manufacturer's procedures and job requirements.
- Record measurements according to work site procedures.
- Compare measurements to manufacturer's specifications for serviceability.
- Separate and mark unserviceable parts according to work site and quality procedures.
- Order replacement parts according to work site procedures.
- Use appropriate tools and equipment according to safety and manufacturers procedures and job requirements.
- Sort parts according to ferrous and non-ferrous metal.
- Give reasons for sorting ferrous and non-ferrous parts.
- Discuss the procedures to order replacement parts.
- Give reason(s) for parts been unserviceable.

### **7.9.3 Subject Outcome 3: Assemble differential.**

#### **Learning Outcomes:**

- Explain procedures to obtain relevant service information.
- Discuss the principles of lubricants related to differentials.
- Discuss safety procedures related to reconditioning differentials. Clean parts before assembly according to safety and work site procedures.
- Assemble differential according to manufacturer's procedures and specifications.
- Apply attachment agents according to manufacturer's procedures and job requirements.
- Used specified lubricants during assembly.
- Perform measurements and/or adjustments during assembly according to manufacturer's procedures and specifications.
- Demonstrate post checks, where necessary or possible, on completion of the reconditioning procedures according to manufacturers and work site procedures.
- Recondition differential according to manufacturers or work site time schedules.
- Give reason(s) for using lubricants and cleaning parts before and during assembly.

- Give reason(s) for measurements and adjustments during assembly.
- Give reason(s) for post-test/checks.

#### **7.9.4 Subject Outcome 4: Complete documentation and report on condition.**

##### **Learning Outcomes:**

- Select and use attachment agents applicable to the task.
- Test / check procedures for differentials prior to dismantling and after reconditioning
- Prepare differential for storage according to manufacturer's and work site procedures.
- Complete documentation according to work site procedures.
- Restore work area to serviceable condition according to work site procedures.
- Discuss reason(s) for preparing vehicle differentials sub-assembly for storage.
- Explain purpose of documentation

### **7.10 Topic 10: Recondition vehicle sub assembly**

#### **7.10.1 Subject Outcome 1: Identify and select correct tools and equipment.**

##### **Learning Outcomes:**

- Use and care for appropriate tools and equipment.
- Explain the method to recondition sub-assembly
- Use and care for measuring instruments related to sub-assembly reconditioning.
- Read and interpret job instructions and determine a sequence of operations according to work site procedures.
- Identify and select appropriate tools and equipment according to job requirements and work site procedures
- Acquire manufacturers' manuals and/or specifications according to job requirements.
- Identify and select appropriate personal protective equipment (PPE) according to statutory requirements.
- Prepare work area and sub-assembly is according to safety, work site and manufacturer's procedures.
- Give reason(s) for selecting appropriate tools and equipment
- Explain reason(s) for selecting appropriate PPE.

#### **7.10.2 Subject Outcome 2: Assess sub-assembly parts.**

##### **Learning Outcomes:**

- Operate an internal combustion engine.
- Identify, name and describe the functions of sub-assembly parts.
- Identify ferrous and non-ferrous metals related sub-assemblies.
- Give methods of assessing serviceability of sub-assembly parts.
- Clean parts, before assessment, according to manufacturers, work site and safety procedures.
- Inspect parts visually for defects according to manufacturer's guidelines.
- Measure parts according to manufacturer's procedures.
- Use measuring equipment according to manufacturer's procedures and job requirements.
- Record measurements according to work site procedures.
- Compare measurements to manufacturer's specifications for serviceability.
- Separate and mark unserviceable parts according to work site and quality procedures.
- Order replacement parts according to work site procedures.
- Use appropriate tools and equipment according to safety and manufacturers procedures and job requirements.
- Sort parts according to ferrous and non-ferrous metal.
- Give reason(s) for sorting ferrous and non-ferrous parts.
- Give reason(s) for parts been unserviceable.

### **7.10.3 Subject Outcome 3: Assemble sub-assembly.**

#### **Learning Outcomes:**

- Obtain procedures for relevant sub assembly specification/general information.
- Explain the principles of lubricants related to internal combustion engines.
- Describe safety procedures related to reconditioning sub-assemblies.
- Clean parts before assembly according to safety and work site procedures.
- Assemble sub-assembly according to manufacturer's procedures and specifications.
- Apply attachment agents according to manufacturer's procedures and job requirements.
- Use specified lubricants during assembly.
- Demonstrate measurements and/or adjustments out during assembly according to manufacturer's procedures and specifications.
- Demonstrate a post-test/check, where necessary or possible, on completion of the reconditioning procedures, according to manufacturers and work site procedures.
- Recondition sub-assembly according to manufacturers or work site time schedules.
- Give reason(s) for using lubricants during assembly.
- Give reason(s) for cleaning parts before assembly.
- Discuss and record reason(s) for measurements and adjustments during assembly.
- Explain the reason(s) for post-test/checks.

### **7.10.4 Subject Outcome 4: Complete documentation and report on condition.**

#### **Learning Outcomes:**

- Discuss the procedures to test/check sub-assembly prior to dismantling and after reconditioning.
- Select and use attachment agents applicable to the task.
- Prepare sub-assembly or storage according to manufacturer's and work site procedures.
- Complete documentation according to work site procedures.
- Restore work area to SHE condition according to work site procedures.
- Give reason(s) for preparing sub-assembly for storage.
- Discuss the purpose of documentation.

## **7.11 Topic 11 repair and test automatic transmission**

### **7.11.1 Subject Outcome 1: Automatic transmission types and applications.**

#### **Learning Outcomes:**

- Identify automatic transmission components and describe their operation
- Trace automatic transmission power flow
- Service, adjust and repair automatic transmission
- Diagnose and repair automatic transmissions and transaxles, including total rebuilding of units.

## **8 RESOURCE NEEDS FOR THE TEACHING OF AUTOMOTIVE REPAIR AND MAINTENANCE - LEVEL 4**

### **8.1 Physical resources**

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

- **Practicum room:**
  - A simulated workshop environment, equipped 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 and 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.), newspapers 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.