NATIONAL CERTIFICATE (VOCATIONAL)

SUBJECT GUIDELINES

AUTOMOTIVE REPAIR AND MAINTENANCE

NQF LEVEL 3

Implementation: January 2014
INTRODUCTION

A. What is Automotive Repair and Maintenance Level 3 about?

This subject builds onto the basic knowledge and skills obtained in Automotive Repair and Maintenance Level 2. This subject entails knowledge of various automotive systems and components. Students acquire knowledge and skills to explain and perform various repair and maintenance tasks on an automotive mobile engine and components, including suspensions, charger and ignition systems, wheels and transmissions.

The content of this subject was revised to address gaps and shortcomings in the first version of the curriculum. The Department of Higher Education and Training worked in close collaboration with stakeholders and role players from both industry and FET colleges who all provided valuable input and participated in the revision process.

B. Why is Automotive Repair and Maintenance important in the learning programme?

Automotive Repair and Maintenance transfers trade-specific skills, knowledge, values and attitudes so that students can explain and illustrate how mechanical tasks are applied in practice.

C. How does the Learning Outcome link with the critical and developmental outcomes?

Automotive Repair and Maintenance covers the basic automotive theory component of the subject outcome. The application of this subject is outcomes-based and relates to the Critical and Developmental Outcomes. Students will be able to:

- **Identify and solve problems:**
  Recognise situations that require action and react appropriately.

- **Work effectively with others:**
  Construct and test projects in groups or teams.

- **Organise and manage themselves and their activities:**
  Apply the correct procedures for using, storing and looking after equipment, tools, and test equipment, drawings and parts.

- **Collect, organise and evaluate information and take appropriate action:**
  Use media centres to collect information.

- **Communicate effectively:**
  Use common names for equipment, tools, test equipment, drawings and parts.

- **Use science and technology:**
  Use and apply science and technology principles in both theory and practice.

- **Demonstrate understanding of subject content through the application of acquired knowledge:**
  Solve problems by using subject content.

D. Which factors contribute to achieving the Learning Outcomes?

- An understanding of technical and electro-mechanical principles
- Analytical ability
- An ability to do mathematical calculations and manipulations
- Practical skills
- Skill to interpret technical information
AUTOMOTIVE REPAIR AND MAINTENANCE – LEVEL 3

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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 OUTCOMES AND FOCUS

SAQA QUALIFICATION ID: 50442

On completion of this subject the student should be able to:

Explain and perform safe and correct checking, maintenance and repair activities on a variety of vehicle engine components and systems.

Range: Petrol and diesel fuel systems, suspension systems, steering geometry, starter systems, charging systems, hydraulic brake systems, ignition systems, manual transmissions, engine removal, replacement and overhaul.

Associated Assessment Criteria:

- The functioning of petrol and diesel fuel systems in vehicles is explained and faultfinding checks and repairs are performed.
- Suspension systems are explained and maintenance tasks are performed on suspension systems.
- Vehicle steering problems are diagnosed and repairs are done on the steering geometry and related components.
- Wheel balancing tasks are carried out according to specifications using a wheel balancing machine.
- The functioning of a starter system is explained and basic starter motor and alternator repairs are performed.
- The principles and functioning of hydraulic brake systems is explained and basic maintenance and repair tasks are completed on brake systems and parts of the brake system.
- The operation of an ignition system and related components is explained and maintenance tasks and repairs are performed.
- The operation and repair of driveline and related components is explained and executed.
- Performance of a basic condition check on the engine of a vehicle is described and performed.
- A vehicle engine is removed and replaced according to manufacturer specifications using appropriate equipment.
- A vehicle engine overhaul is performed adhering to safety regulations and a comprehensive report is compiled.
3. ASSESSMENT

Information provided in this document on internal and external assessment aims to inform, assist and guide lecturers to plan the effective teaching of the subject.

The Assessment Guidelines accompanying this document provide detailed information for planning and conducting internal and external assessments.

3.1 Internal assessment (50 percent)
Detailed information regarding internal assessment and moderation is outlined in the current Internal Continuous Assessment (ICASS) Guideline document provided by the Department of Higher Education and Training (DHET).

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. A practical component, the Integrated Summative Assessment Task (ISAT) will be included in external assessment.


4 WEIGHTED VALUES OF TOPICS

<table>
<thead>
<tr>
<th>TOPICS</th>
<th>WEIGHTED VALUE</th>
<th>*TEACHING HOURS</th>
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<tbody>
<tr>
<td>1. Fundamentals of Fuel Systems</td>
<td>10%</td>
<td>11</td>
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<tr>
<td>2. Maintenance and Repair of Suspension Systems</td>
<td>8%</td>
<td>8</td>
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<td>3. Checking and Adjusting of Steering Geometry</td>
<td>5%</td>
<td>6</td>
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<td>4. Wheel Balancing</td>
<td>10%</td>
<td>11</td>
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<tr>
<td>5. Maintenance and Repair of Starting Systems</td>
<td>8%</td>
<td>9</td>
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<td>6. Maintenance and Repair of Charging Systems</td>
<td>8%</td>
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<tr>
<td>7. Maintenance and Repair of Hydraulic Brake Systems</td>
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<tr>
<td>10. Removal and Replacement of a Vehicle Engine</td>
<td>10%</td>
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<tr>
<td>11. Overhauling of a Vehicle Engine</td>
<td>10%</td>
<td>11</td>
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<tr>
<td>12. Maintenance and Repair of Driveline and Related Components</td>
<td>8%</td>
<td>9</td>
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<tr>
<td>TOTAL</td>
<td>100%</td>
<td>110</td>
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*Teaching Hours refers to the minimum hours required for face to face instruction and teaching. This excludes time spent on revision, tests and internal and external examination/assessment. The number of allocated teaching hours is influenced by the topic weighting, complexity of the subject content and the duration of the academic year.

5 CALCULATION OF FINAL MARK

Internal assessment mark: Student’s mark/100 x 50 = a mark out of 50 (a)
Examination mark: Student's mark/100 x 50 = 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, among others, reporting, and moderation and verification purposes.

6 PASS REQUIREMENT
The student must obtain at least fifty (50) percent in ICASS and fifty (50) percent in the examination to achieve a pass in this subject.

7 SUBJECT AND LEARNING OUTCOMES
On completion of Automotive Repair and Maintenance Level 3 the student should have covered the following topics:
Topic 1: Fundamentals of Fuel Systems
Topic 2: Maintenance and Repair of Suspension Systems
Topic 3: Checking and Adjusting of Steering Geometry
Topic 4: Wheel Balancing
Topic 5: Maintenance and Repair of Starting Systems
Topic 6: Maintenance and Repair of Charging Systems
Topic 7: Maintenance and Repair of Hydraulic Brake Systems
Topic 8: Maintenance and Repair of Ignition Systems
Topic 9: Performance of a Basic Condition Test on a Vehicle Engine
Topic 10: Removal and Replacement of a Vehicle Engine
Topic 11: Overhauling of a Vehicle Engine
Topic 12: Maintenance and Repair of Driveline and Related Components

Topic 1: Fundamentals of Fuel Systems

Subject Outcome 1.1: Explain petrol as an automotive fuel.
Learning Outcomes:
- Explain safety procedures for use when working with flammable fluids and gases
- Describe different types and grades of petrol.
- Describe different additives used in petrol.
- Explain how air and petrol mix to form a gas.
- Describe the petrol combustion process

Subject Outcome 1.2: Explain the operation of a petrol fuel system.
Learning Outcomes:
- Explain safety procedures for working on Electronic Fuel Injection (EFI) components.
- Explain the operation of single and twin choke carburettors.
- Explain different carburettor circuits used at different throttle positions.
- Explain mixture adjustments to improve emission levels in a carburettor.
• Identify different components and their function on the Electronic Fuel Injection (EFI) system.

**Subject Outcome 1.3: Perform selected tasks on petrol fuel systems**

**Learning Outcomes:**
- Use a hand vacuum pump to check vacuum controls.
- Complete a basic carburettor service check.
- Complete a fuel pump check.
- Complete a faultfinding check on different carburettors and provide possible solutions for repairs.

**Subject Outcome 1.4: Explain diesel as an automotive fuel.**

**Learning Outcomes:**
- Explain different types and grades of diesel.
- Describe different additives used in diesel.
- Explain how air and diesel mix to form a gas.
- Describe the diesel combustion process

**Subject Outcome 1.5: Explain the operation of a diesel fuel system.**

**Learning Outcomes:**
- Explain safety procedures for working on diesel fuel injection components.
- Explain the operation of an in-line injector pump.
- Explain the operation of a rotary injector pump
- Explain the operation of different types of diesel injectors
- Explain the operation of different types of glow plugs
- Explain different systems to improve emission levels in a diesel fuel system.

**Subject Outcome 1.6: Perform selected tasks on diesel fuel systems**

**Learning Outcomes:**
- Determine specifications and procedures on diesel injection systems from a manual.
- Identify special tools for testing or working on a fuel injection system.
- Complete a standard service on a diesel fuel system according to manufacturer’s specifications.
- Use an injector tester to test an injector according to manufacturer’s specifications.
- Check and adjust the timing of the injector pump in a diesel fuel system.

**Topic 2: Maintenance and Repair of Suspension Systems**

**Subject Outcome 2.1: Explain the construction of different suspension systems**

**Learning Outcomes:**
- Describe different front suspension systems and the functioning of individual components
- Describe different rear suspension systems and the functioning of individual components
- Explain the importance of suspension systems in relation to safety and comfort
• Explain the working of different shock absorber systems
• Identify special tools for testing or working on car suspension systems

**Subject Outcome 2.2: Perform selected maintenance tasks on suspension systems**

**Learning Outcomes:**
• Explain safety procedures for working on a car’s suspension.
• Perform a general check on a car’s suspension according to manufacturer’s specifications.
• Replace the shock absorber of a car.
• Remove, replace and adjust a wheel bearing
• Replace different suspension bushes on the suspension of a car.

**Subject Outcome 2.3: Diagnose and repair various front suspension system problems.**

*Range: Ride height, body sway, McPherson strut, SLA components, linkages, knuckle assemblies, ball joints, and bearing plated assemblies.*

**Learning Outcomes:**
• Determine the root cause for front suspension problems
• Perform various repairs to solve front suspension system problems

**Subject Outcome 2.4: Diagnose and repair various rear suspension system problems.**

*Range: Ride height, body sway, SLA components, linkages, knuckle assemblies, ball joints, and bearing plated assemblies.*

**Learning Outcomes:**
• Determine root cause for rear suspension problems
• Perform various repairs to solve rear suspension system problems

**Topic 3: Checking and Adjusting of Steering Geometry**

**Subject Outcome 3.1: Plan and prepare for checking and adjusting steering geometry.**

**Learning Outcomes:**
• Explain steering geometry of an automotive vehicle
  *Range: Ackermans angle, toe out on turns, over steer and under steer*
• Determine specifications and equipment to check and adjust the steering geometry.
• Describe safety aspects for using a wheel alignment machine to check the steering geometry

**Subject Outcome 3.2: Explain and perform pre-checks on suspension components relating to steering geometry.**

**Learning Outcomes:**
• Explain required procedures for checking and adjusting a steering geometry
• Apply safety procedures for checking and adjusting steering geometry.
• Observe and record unusual tyre wear patterns.
• Check and adjust tyre air pressure.
• Diagnose steering column noises and operation.
- Diagnose manual steering gear and adjustment.
  *Range ball joints, king pins, shock absorbers, springs*
- Diagnose manual rack and pinion steering gear and adjustment.
- Check nut torque settings according to factory recommendations and adjust if necessary.
- Check wheel bearings and adjustment

**Subject Outcome 3.3: Analyse information and compile a condition report on suspension components.**

**Learning Outcomes:**
- Explain findings and results of pre-checks according to selected criteria.
- Compare and interpret findings of conditions of components.
- Compile a report on the overall condition of the suspension components
- Submit the report to the workshop manager or facilitator.

**Subject Outcome 3.4: Perform wheel alignment and adjustment.**

**Learning Outcomes:**
- Explain the theory of wheel alignment, angles and their functions
  *Range: All aspects of toe in and toe out, caster angles and camber angles, King Pin Inclination (KPI) and Steering Axis Inclination (SAI) principles*
- Check and adjust vehicle steering problems
- Check and adjust caster and camber angles
- Check and adjust toe in and toe out
- Check and adjust steering axis inclination (SAI) and king pin inclination (KPI)

**Topic 4: Wheel Balancing**

**Subject Outcome 4.1: Plan and prepare work area and vehicle for a wheel balancing task.**

**Learning Outcomes:**
- Obtain, read and interpret task instructions or job card.
- Remove any potential obstacles and clean the work and surrounding areas.

**Subject Outcome 4.2: Prepare the wheel balancing machine.**

**Learning Outcomes:**
- Inspect the safety and operational condition of the equipment to ensure the correct calibration and proper working of mechanical and electrical components.
- Collect the appropriate tools to perform wheel balancing
- Arrange the size of balancing weights.
- Load necessary information into computer storage systems
  *Range: Wheel specifications, size, diameter, width, any other requirements of the machine*
Subject Outcome 4.3: Balance the wheel

Learning Outcomes:
- Interpret and apply information on computer storage systems
- Inspect rims and tyres for damage and wear.
- Mount the wheel onto the machine.
- Perform static balancing of the wheel
- Perform dynamic balancing of the wheel

Topic 5: Maintenance and Repair of Starting Systems

Subject Outcome 5.1: Explain the working of the starting system

Learning Outcomes:
- Describe the electrical circuit of the starting system.
- Explain the working of different types of starter motors.
- Explain the working of the different parts of the starter motor.
- Explain safety procedures for working on the starting system.

Subject Outcome 5.2: Perform a starter check on a vehicle.

Learning Outcomes:
- Perform a visual inspection on the starting system and identify possible faults.
- Start the motor and measure the voltage drop of the battery
- Measure the starting current through the starting system.
- Use the battery voltage drop and starting current measurements to draw conclusions on the condition of the starter.

Subject Outcome 5.3: Perform basic maintenance on the motor of a starter.

Learning Outcomes:
- Remove the starter motor from a vehicle
- Disassemble the starter motor. 
  Range: relay, armature shaft, housing, brushes, pinion.
- Check all the parts according to manufacturer’s specifications.
- Replace the damaged or worn parts.
- Assemble the starter motor and test its performance.
- Replace the starter motor and check the functioning of the starting system.

Topic 6: Maintenance and Repair of Charging Systems

Subject Outcome 6.1: Explain the working of the charging system

Learning Outcomes:
- Describe the electrical circuit of the charging system.
- Differentiate alternating current (AC) and direct current (DC) electrical circuits
• Explain the functioning of alternating current (AC) and direct current (DC) generators where still in use
• Explain the functioning of different parts of the alternator.  
  \textit{Range: Rotor, stator, rectifier, regulator.}
• Explain safety procedures for working on the charging system.

\textbf{Subject Outcome 6.2: Perform basic checks and maintenance on the charging system.}

\textbf{Learning Outcomes:}
• Perform a visual check on the charging system and identify possible faults
• Start the engine and measure the alternator charging output voltage
• Measure the charging current and maximum output through the charging system.
• Measure the voltage between the negative terminal of the battery and the chassis.
• Check the charging system and identify possible faults.
• Check the driving belt condition and tension.
• Replace the belt, if necessary, and adjust the tension.

\textbf{Subject Outcome 6.3: Perform basic alternator maintenance}

\textbf{Learning Outcomes:}
• Remove the alternator from the vehicle.
• Dissassemble the alternator.  
  \textit{Range: rotor, stator, pulley, rectifier, regulator, brushes.}
• Check all the parts according to factory specifications.
• Replace the damaged or worn parts.
• Assemble the alternator and test its performance.
• Replace the alternator and check the functioning of the charging system.

\textbf{Topic 7: Maintenance and Repair of Hydraulic Brake Systems}

\textbf{Subject Outcome 7.1: Explain the theory of hydraulic brake systems.}

\textbf{Learning Outcomes:}
• Explain the application of fundamental laws of hydraulic brake systems.
• Explain the characteristics and properties of liquids as applied to brake fluid
• Explain the operation of the hydraulic brake system.
• Explain the legal requirements for brake deceleration.

\textbf{Subject Outcome 7.2: Explain the functioning and operation of the hydraulic brake system.}

\textbf{Learning Outcomes:}
• Describe the functioning and operating principles of the brake system components.  
  \textit{Range: Different parts of drum brakes, different parts of disc brakes, hand brake, brake booster, brake pressure controller}
• Explain manual and pressure bleeding of brakes
• Explain safety procedures for working on the brake system.

**Subject Outcome 7.3: Perform basic maintenance on the brake system.**

**Learning Outcomes:**
- Check the brake system.
*Range: brake shoes of a drum brake system, brake pads of a disc brake system, handbrake, brake fluid in the brake system, the fluid-level sensor and brake pedal switch.*
- Replace the damaged or worn components of the brake system.
- Check for possible faults on the hydraulic brake system.
- Check the brake pressure controller.
- Check the drum diameter and/or disk thickness and compare with manufacturer’s specifications
- Re-fill the brake fluid.
- Adjust the handbrake.

**Subject Outcome 7.4: Diagnose and repair various parts of the brake system.**

**Learning Outcomes:**
- Remove the wheel brake cylinder of a drum brake system
- Disassemble the wheel cylinder and replace the seals
- Assemble the wheel brake cylinder
- Refit the wheel brake cylinder to the vehicle
- Remove the brake caliper of the disc brake system
- Clean the inside of the cylinder and replace the seals
- Assemble the brake caliper and refit it to the vehicle
- Replace the brake hose of the hydraulic brake system
- Remove the brake master cylinder
- Disassemble the master cylinder and inspect the parts
- Replace the worn parts
- Assemble the brake master cylinder
- Refit the brake master cylinder to the vehicle and bleed the system.

**Topic 8: Maintenance and Repair of Ignition Systems**

**Subject Outcome 8.1: Explain the operation of a conventional and an advanced ignition system**

**Learning Outcomes:**
- Describe the function and operating principles of the ignition system
- Explain the importance of ignition timing and dwell angle
- Explain the construction and operation of the ignition system
*Range: the ignition coil, the distributor with contact breaker points, a ballast resistor and condenser, the transistor ignition, the centrifugal and vacuum advance mechanism*
- Explain the operation of the distributor with inductive, hall or optical sensors
• Explain the operation of distributor-less ignition (dual spark, coil on plug)
• Explain the construction and operation of the spark plug
• Explain safety procedures for working on the ignition system.

Subject Outcome 8.2: Perform basic maintenance on the ignition system.

Learning Outcomes:
• Remove, clean and inspect spark plugs.
• Adjust spark plugs according to manufacturer’s specifications and replace where necessary.
• Check and replace high tension leads.
• Replace the contact breaker points and adjust the opening gap according to the manufacturer’s specifications.
• Check and adjust the ignition timing using a timing light according to the manufacturer’s specifications.
• Inspect the ignition system and identify possible faults.

Subject Outcome 8.3: Diagnose and repair various parts of the ignition system.

Learning Outcomes:
• Remove a distributor assembly from the engine.
• Disassemble the distributor.
• Check all components for mechanical wear
  Range: shaft, cam, advance mechanism, breaker points, drive gear.
• Check all electrical parts.
  Range: wires, contacts, condenser, rotor, cap.
• Replace the worn parts
• Assemble the distributor.
• Test the distributor assembly on a test bench and carry out necessary dwell angle adjustments.
• Refit the distributor assembly on the engine using appropriate tools and adjust the ignition timing.

Topic 9: Performance of a Basic Condition Test on a Vehicle Engine

Subject Outcome 9.1: Describe basic condition test procedures

Learning Outcomes:
• Describe the procedure to perform a cylinder compression test
• List all the different conditions of the engine that will influence the compression
• Describe the procedure to perform a cylinder leakage test
• List all the different conditions of the engine that will influence the leakage percentage
• Acquire the manufacturer’s specifications for the cylinder compression test of a particular engine
• Acquire the manufacturer’s specifications for the cylinder leakage test of a particular engine.

Subject Outcome 9.2: Use test equipment to perform assessment of the engine condition
Learning Outcomes:
- Clean the engine compartment
- Warm up the engine to operating conditions
- Prepare the engine for the cylinder compression test
- Use a compression tester to measure the compression of the individual cylinders
- Prepare the engine for the cylinder leakage test
- Use a cylinder leakage tester to measure the leakage percentage of the individual cylinders.

Subject Outcome 9.3: Compare the outcomes of the 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.

Subject Outcome 9.4: 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.

Topic 10: Removal and Replacement of a Vehicle Engine

Subject Outcome 10.1: Explain procedures and perform cleaning of automotive components.

Learning Outcomes:
- Describe proper cleaning procedures for automotive components.
- Explain the functioning and operation of the cleaning equipment.
- Clean the engine compartment for inspection.

Subject Outcome 10.2: Explain how to remove an engine from a vehicle according to manufacturer’s specifications.

Learning Outcomes:
- Use an appropriate manual to identify tools and equipment needed for removing the engine from the engine compartment
- Describe correct preparation of the work area for removal of the engine.
- Explain safety precautions and procedures to follow when removing a vehicle engine.
- Explain safety procedures to follow for storage of the engine.

Subject Outcome 10.3: Remove the engine from the vehicle.

Learning Outcomes:
• Prepare the engine for removal.
  Range: Includes but is not limited to removal of wires, cables, mountings hoses.
• Remove the engine from the engine compartment
• Assure proper re-installation by marking all relevant mechanical and electrical connections.
• Store the engine for further disassembly if required

**Subject Outcome 10.4: Replace the engine in the vehicle.**

**Learning Outcomes:**
• Prepare the engine for re-installment
• Replace the engine in the engine compartment
• Make all necessary mechanical and electrical connections
• Test the vehicle to ensure proper re-installation.

**Topic 11: Overhauling of a Vehicle Engine**

**Subject Outcome 11.1: Remove engine components**

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

**Subject Outcome 11.2: Assess components according to specifications.**

**Learning Outcomes:**
• Identify different parts/components.
• Explain the function of the different parts/components.
• Inspect, measure and record the condition of different parts/components.
  Range: cylinder blocks and heads, piston and connecting rod assemblies, camshaft, gear chain and timing, crankshaft and bearings.

**Subject Outcome 11.3: Compile and submit a condition report on services required**

**Learning Outcomes:**
• Interpret findings on serviceability of parts and components.
• Record and submit necessary information on services required.

**Subject Outcome 11.4: Repair components.**

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

**Learning Outcomes:**
• 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.

Subject Outcome 11.5: Assemble according to manufacturer’s specifications/procedures

Learning Outcomes:
• Use a manual to determine manufacturer’s specifications and procedures on assembling.
• Determine the correct placement of components.
• Carefully assemble combined components to avoid faulty procedures.
• Complete final checking on all specifications after assembling.

Topic 12: Maintenance and Repair of Driveline and Related Components

Subject Outcome 12.1: Explain the functioning of transmissions and related components

Learning Outcomes:
• Explain different types of gears
• Explain the relationship between the gear ratio and torque
• Explain the functioning of a transmission/gearbox
• Explain different types of gear lever arrangements
• Describe different types of transmissions/gearboxes
  Range: sliding mesh, constant mesh, synchromesh
• Explain the power flow through different gears in a gearbox
• Explain the operational principles of different mechanical and hydraulic clutches used in cars
• Identify and describe the operation of different components of a clutch system.

Subject Outcome 12.2 Perform repairs on transmissions/gearboxes

Learning outcomes:
• Describe safety procedures for working on transmissions/gearboxes
• Use a manual to identify the factory specifications on transmission/gearbox lubricants and service procedures
• Remove the transmission/gearbox from the vehicle
• Disassemble the transmission/gearbox and inspect all relevant parts for wear
• Compile and submit a condition report
• Replace worn or damaged parts
• Assemble the transmission/gearbox according to factory specifications
• Re-install the complete transmission/transaxle driveline and test it
• Complete relevant documentation to record repairs

Subject Outcome 12.3: Describe the operation of a final drive and differential

Learning Outcomes:
• Describe different types of final drives
  Range: bevel drives and worm drives
• Explain the operational principles of a final drive and differential.
• Explain the functioning of differential components
• Explain different power flows through a differential  
  Range: straight drive, left turn, right turn

Subject Outcome 12.4: Perform repairs on a final drive

Learning Outcomes:
• Describe safety procedures for working on differentials and final drives  
• Obtain necessary factory specifications for differentials and final drives  
• Remove the final drive from the vehicle  
• Disassemble the final drive and inspect the components for wear  
• Compile and submit a condition report  
• Replace worn or damaged parts  
• Assemble the differential and final drive  
• Re-install the differential and final drive in the vehicle.

Subject Outcome 12.5: Explain drive line components and arrangement

Learning Outcomes:
• Describe different types of drivelines  
  Range: cross joints, propeller shafts, slip yokes, rubber trunnion, ring joint, layrub and constant velocity joint.  
• Explain the phasing of a propeller shaft.

Subject Outcomes 12.6: Perform repairs on driveline components  

Range: Cross joints, propeller shafts, slip yokes, rubber trunnion, ring joint, layrub and constant velocity joint.

Learning Outcomes:
• Remove different driveline components  
• Dissassemble different driveline components  
• Replace worn or damaged parts  
• Assemble different driveline components  
• Replace different driveline components  
• Lubricate all necessary parts in the driveline according to factory specifications.

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

8.1 Physical resources
• A fully equipped workshop with all the necessary tools and equipment required to achieve the outcomes expected in this subject  
• Availability of computers and printers for students to complete assignments or case studies and to conduct research  
• Research software, for example Encarta  
• Subject related magazines (Motor Vehicle Technology; Auto Data Book & Technique, etc.), newspapers related to subject and subject-related reference books
• Subject-related DVDs and videos
• List of stakeholders prepared to be involved in the learning process through making presentations or providing the opportunity for students to gain practical experience
• Applicable legislation or Acts for use by lecturers during lessons and students for research purposes
• Stock room to store video or DVD machines, televisions, etc.
• Security for stockroom, media centre and practicum room.
• Computer and data projector or latest technology to electronically project data for students
• Flash disk for lecturer to store information
• Presentation programme on computer to be used by lecturer to provide students with visual information on Learning Outcomes
• White board, black board and pull-down screen
• Desks big enough for students to work on

8.2 Human resources

Lecturing staff must be appropriately qualified and must possess the necessary knowledge, skills and reflexive approach to ensure that students’ learning is kept up to date with the latest technologies and changing trends in their specialist field.

Continuous staff development with exposure to an industrial environment is necessary for lecturers to acquire new skills and to update their existing skills where new technologies have been introduced. Lecturers are required to spend a structured and routine period annually in an industrial environment for these purposes.

Staff development in terms of updating teaching, learning and assessment skills is required on an ongoing basis, particularly for staff that move from industry into the educational environment of an FET College.

8.3 Other Resources

The institution should have funding available to provide the following:
• consumables necessary to perform practical assignments and examinations
• maintenance of physical resources
• purchasing of new equipment.