

**THE REPUBLIC OF KENYA**

**COMPETENCY-BASED MODULAR CURRICULUM**

**FOR**

**AUTOMOTIVE ENGINEERING TECHNOLOGY**

**KNQF LEVEL 5**

**PROGRAMME ISCED CODE: 0716 454A**

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# FOREWORD

The provision of quality education and training is fundamental to the Government’s overall strategy for social and economic development. Quality education and training contribute to the achievement of Kenya’s development blueprint and sustainable development goals.

Reforms in the education sector are necessary to achieve Kenya Vision 2030 and meet the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution, and this resulted in the formulation of the Policy Framework for Reforming Education and Training in Kenya (Sessional Paper No. 14 of 2012). A key feature of this policy is the radical change in the design and delivery of TVET training. This policy document requires that training in TVET be competency-based, curriculum development be industry-led, certification be based on demonstration of competence, and the mode of delivery allow for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that this curriculum has been developed. For trainees to build their skills on foundational hands-on activities of the occupation, units of learning are grouped in modules. This has eliminated duplication of content and streamlined exemptions based on skills acquired as a trainee progresses in the up-skilling process, while at the same time allowing trainees to be employable in the shortest time possible through the acquisition of part qualifications.

It is my conviction that this curriculum will play a great role in developing competent human resources for the Automotive Engineering Technology Sector’s growth and development.

**PRINCIPAL SECRETARY**

**STATE DEPARTMENT FOR TVET**

**MINISTRY OF EDUCATION**

# PREFACE

Kenya Vision 2030 aims to transform Kenya into a newly industrializing middle-income country, providing high-quality life to all its citizens by the year 2030. Kenya intends to create globally competitive and adaptive human resource base to meet the requirements of a rapidly industrializing economy through lifelong education and training. TVET has a responsibility to facilitate the process of inculcating knowledge, skills, and worker behaviour necessary for catapulting the nation to a globally competitive country, hence the paradigm shift to embrace Competency-Based Education and Training (CBET).

CAP 210A and Sessional Paper No. 1 of 2019 on Reforming Education and Training in Kenya for Sustainable Development emphasized the need to reform curriculum development, assessment, and certification. This called for a shift to CBET to address the mismatch between skills acquired through training and skills needed by industry, as well as increase the global competitiveness of the Kenyan labour force.

This curriculum has been developed in adherence to the Kenya National Qualifications Framework and CBETA standards and guidelines. The curriculum is designed and organized into Units of Learning with Learning Outcomes, suggested delivery methods, learning resources, and methods of assessing the trainee’s achievement. In addition, the units of learning have been grouped in modules to concretize the skills acquisition process and streamline upskilling.

I am grateful to all expert trainers and everyone who played a role in translating the Occupational Standards into this competency-based modular curriculum.

# ACKNOWLEDGMENT

This curriculum has been designed for competency-based training and has independent units of learning that allow the trainee flexibility in entry and exit. In developing the curriculum, significant involvement and support were received from expert trainers, institutions and organizations.

I recognize with appreciation the role of the Engineering and Manufacturing National Sector Skills Committee (NSSC) in ensuring that competencies required by the industry are addressed in the curriculum. I also thank all stakeholders in the Automotive Engineering Technology sector for their valuable input and everyone who participated in developing this curriculum.

I am convinced that this curriculum will go a long way in ensuring that individuals aspiring to work in the Automotive Engineering Technology Sector acquire competencies to perform their work more efficiently and effectively.

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**ABBREVIATIONS AND ACRONYMS**

ICT Information and Communication Technology

KCSE Kenya Certificate of Secondary Education

KNQA Kenya National Qualification Authority

OBD On-board diagnostics

PPE Personal protective equipment

CV Curriculum vitae

CDs Compact Disc

DVDs Digital Video Disc

HDMI High-Definition Multimedia Interface

DVI Digital visual interface

VGA Video Graphics Array

USB Universal Serial Bus

CPU Computer Processing Unit

RAM Random access memory

AC Alternating current

DC Direct Current

ABS Anti-Lock Braking system

KNQF Kenya National Qualification Framework

ISCED International Standard Classification of Education

URIs Uniform Resource Identifiers

**KEY TO ISCED UNIT CODE**



# COURSE OVERVIEW

The Automotive Engineering Technology Level 5 curriculum consists of competencies that a person must achieve to enable him/her to perform maintaining vehicle engine, maintaining vehicle transmission system, maintaining vehicle braking system, maintaining vehicle suspension and steering system, and maintaining automotive electrical systems.

The units of competency comprising Automotive Engineering Technology Level 5 qualifications include the following competencies:

**SUMMARY OF UNITS OF LEARNING**

|  |  |  |  |
| --- | --- | --- | --- |
| **MODULE I** | | | |
| **Unit Code** | **Units Title** | **Unit Duration (Hours)** | **Credit Factor** |
| 0716 251 01A | Vehicle Petrol Engine Maintenance | 200 | 20.0 |
| 0716 251 02A | Vehicle Braking System Maintenance | 100 | 10.0 |
| **MODULE II** | | | |
| 0716 351 03A | Vehicle Diesel Engine maintenance | 180 | 18.0 |
| 0716 551 04A | Vehicle Suspension and steering system Maintenance | 160 | 16.0 |
| **MODULE III** | | | |
| **BASIC UNIT OF LEARNING** | | | |
| 0031 441 05A | Communication Skills | 40 | 4.0 |
| 0417 441 06A | Work Ethics and Practices | 40 | 4.0 |
| **COMMON UNIT OF LEARNING** | | | |
| 0541 441 07A | Applied Mathematics | 80 | 8.0 |
| 0732 451 08A | Technical Drawing | 80 | 8.0 |
| **CORE UNITS OF LEARNING** | | | |
| 0716 451 9A | Vehicle Fuel System Maintenance | 120 | 12.0 |
| 0716 551 10A | Automotive Electrical Systems Maintenance | 120 | 12.0 |
| **MODULE IV** | | | |
| **BASIC UNIT OF LEARNING** | | | |
| 0611 441 11A | Digital Literacy | 40 | 4.0 |
| 0413 441 12A | Entrepreneurial Skills | 40 | 4.0 |
| **COMMON UNIT OF LEARNING** | | | |
| 0715 451 13A | Workshop Technology | 80 | 8.0 |
| 0715 441 14A | Mechanical Science | 80 | 8.0 |
| 0713 441 15A | Electrical and Electronics Principles | 80 | 8.0 |
| **CORE UNITS OF LEARNING** | | | |
| 0716 451 16A | Vehicle Transmission System Maintenance | 150 | 15.0 |
| **Industrial Attachment** | | **480** | **48.0** |
| **GRAND TOTAL** | | **2070** | **20.70** |

**Entry Requirements**

An individual entering this course should have any of the following minimum requirements:

1. Kenya Certificate of Secondary Education (KCSE) mean grade D (plain) or KCE Division III

Or

1. Automotive Technology KNQF level 4 certificate

Or

c)      Any other qualification equivalent to Automotive Technology as determined by TVETA.

**Trainer qualification**

A trainer for any of the Units of Competency in this course must:

1. Have a minimum of KNQF level 6 certificate in Automotive Engineering Technician or its equivalent.
2. Be registered by TVETA.
3. Registered by Engineer Board of Kenya (E.B.K) or Kenya Engineering Technology Registration Board (KETRB).

**Industrial attachment**

An individual enrolled in this course will be required to undergo Industry training for a minimum period of 480 hours in Automotive Technician sector. The industrial training may be taken after completion of all units for those pursuing the full qualification or be distributed equally in each unit for those pursuing part qualification. In the case of dual training model, industrial training shall be as guided by the dual training policy.

**Assessment**

The course shall be assessed formatively and summative:

1. During formative assessment all performance criteria shall be assessed based on performance criteria weighting.
2. Number of formative assessments shall minimally be equal to the number of elements in a unit of competency.
3. During summative assessment basic and common units may be integrated in the core units or assessed as discrete units.
4. Theoretical and practical weight shall be as follows:
5. 10:90 for unit in module 1 and module 2 for each unit of learning.
6. 30:70 for units in module 3 and module 4 for each unit of learning.
7. Formative and summative assessments shall be weighted at 60% and 40% respectively in the overall unit of learning score
8. For a candidate to be declared competent in a unit of competency, the candidate must meet the following conditions:
9. Obtained at least 40% in theory assessment in formative and summative assessments.
10. Obtained at least 60% in practical assessment in formative and summative assessment where applicable.
11. Obtained at least 50% in the weighted results between formative assessment and summative assessment where the former constitutes 60% and the latter 40% of the overall score.
12. Assessment performance rating for each unit of competency shall be as follows:

|  |  |
| --- | --- |
| **MARKS** | **COMPETENCE RATING** |
| 80 -100 | Attained Mastery |
| 65 - 79 | Proficient |
| 50 - 64 | Competent |
| 49 and below | Not Yet Competent |
| Y | Assessment Malpractice/irregularities |

1. Assessment for Recognition of Prior Learning (RPL) may lead to award of part and/or full qualification.

**Certification**

A candidate will be issued with a Certificate of Competency upon demonstration of competence in a core Unit of Competency. To be issued with Kenya National TVET Certificate in Automotive Engineering Technician KNQF Level 5, the candidate must demonstrate competence in all the Units of Competency as given in the qualification pack. A Statement of Attainment certificate may be issued upon demonstration of competence in a certifiable element within a unit.

The certificates will be issued by the Qualification Awarding Institution

# MODULE I

# **VEHICLE PETROL ENGINE MAINTENANCE**.

**UNIT CODE: 0716 251 01A**

**UNIT DURATION:** 200Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Maintain vehicle Petrol Engine.

**Unit Description**

This unit specifies competencies required to maintain vehicle engine. It involves performing Servicing vehicle engine, Overhauling Vehicle Engine, Servicing vehicle engine lubrication system and Performing House keeping

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Service petrol engine | 60 |
|  | Overhaul petrol Engine | 60 |
|  | Service petrol engine lubrication system | 35 |
|  | Service petrol fuel system | 35 |
|  | Perform House keeping | 10 |
| TOTAL | | 200 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Service petrol engine | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures   2. Engine classification      1. Operating cycles         1. 4 stroke cycle-petrol engine         2. 2-stroke cycle-petrol engine   3. Petrol Engine components and their functions      1. Cylinder head components      2. Engine block components      3. Valve assembly components      4. Cooling components      5. Lubrication components   4. Petrol Engine inspection      1. Visual checks         1. Leaks         2. Belts and hoses         3. Battery condition      2. Fluid levels and quality         1. Engine oil         2. Coolant level         3. Fuel lines      3. Air intake and filtration         1. Air filter         2. Intake manifold      4. Exhaust system         1. Exhaust manifold         2. Exhaust emissions      5. Spark plug and ignition system         1. Spark plugs         2. Ignition coils and wires   5. Engine tools, equipment and materials      1. Uses and maintenance practices         1. Assorted tools         2. Torque wrench         3. Engine stand         4. Ring compressor         5. Feeler gauge         6. Valve spring compressor         7. Micrometer gauge         8. Dial gauge         9. Compression tester   6. Petrol Engine components replacement/service      1. Oil filter      2. Air filter      3. Fuel filter      4. Spark plug      5. Belts      6. Brake fluid top up      7. Coolant top up | * Practical * Project * Portfolio of evidence * Third party report * Written tests * Oral questioning |
| 1. Overhaul Petrol Vehicle Engine | * 1. Petrol engine dismantling      1. Purpose for dismantling      2. Dismantling procedure      3. Cleaning parts   2. Petrol engine parts inspection      1. Leak detection      2. Crack detection      3. Measurements      4. Warping   3. Petrol Engine parts service/replacement      1. Cylinder block and cylinder walls      2. Piston and piston rings      3. Crankshaft and bearing      4. Cylinder head and valves      5. Connecting rod      6. Camshaft and timing components      7. Gasket and seals   4. Petrol engine parts assembly      1. Assembly procedure      2. Timing      3. Engine tune up   5. Petrol engine fitting and mounting      1. Fitting procedure      2. Engine mounting   6. Re installation check      1. Visual checks      2. Fluid checks      3. Alignment and clearance checks      4. Exhaust system checks      5. Cooling system checks      6. Fuel system pressure check |  |
| * Practical * Project * Portfolio of evidence * Third party report * Written tests * Oral questioning |
| 1. Service Vehicle Petrol engine lubrication system | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures   2. Lubrication system      1. Functions      2. Lubrication system construction and operation      3. Types of lubricants   3. Engine lubrication system diagnosis and remedies      1. Low oil pressure      2. Excessive oil consumption      3. Oil leaks      4. Oil contamination   4. Engine lubrication system service tools, equipment and materials      1. Uses and maintenance   5. Engine lubrication system inspection      1. Leakage      2. Oil pump operation      3. Oil levels      4. Oil seals      5. Oil filter   6. Engine lubrication system service/replacement      1. Leakage      2. Oil pump operation      3. Lubricating oil      4. Oil seals      5. Oil filter      6. Gaskets   7. Lubrication system parts installation      1. Components fitting      2. Reinstallation checks   8. Lubrication system operation tests      1. Oil pressure test      2. Leak inspection      3. Oil level check | * Practical * Project * Portfolio of evidence * Third party report * Written tests * Oral questioning |
| 1. Service petrol fuel system | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures      4. Housekeeping practices      5. Waste disposal   2. Fuel system operation      1. Petrol fuel system   3. Layout      1. Throttle body injection system      2. Multipoint injection system      3. Direct petrol injection (GDI)   4. Fuel system service tools and equipment      1. Uses and maintenance practices   5. Fuel system diagnosis and remedies      1. Short circuit      2. Open circuits   6. Fuel system inspection      1. Serviceability      2. Leakages      3. Clogging      4. Spray pattern   7. Fuel system components service/replacement      1. Fuel filter      2. Fuel injector      3. Fuel pump      4. Blockage      5. Injector nozzles   8. Fuel system re installation checks      1. Fuel lines      2. Pressure check      3. Injector functionality      4. Leak checks | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Perform housekeeping | * 1. Housekeeping      1. Definition      2. Importances   2. Work area preparation      1. Preparing tools and equipment      2. Setting up workplace      3. Cleaning during and after work   3. Handling engine fluids and hazardous materials      1. Types of engine fluids      2. Safe handling and disposal      3. Personal protective equipment   4. Waste management      1. Types of waste in engine maintenance      2. Waste segregation      3. Recycling and environmental responsibility | * Practical * Project * Portfolio of evidence * Third party report * Written tests * Oral questioning |

**Suggested Methods of Instruction**

* + Demonstrations
  + Practical
  + Projects
  + Group Discussion
  + Direct instructions

The delivery may also be supplimented and enhanced by the following , if the opportunity allows;

* Visiting lecturer/trainer from the motor vehicle service and repair sector
  + Industrial visits

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
| 1 | Textbooks | Comprehensive texts on engine service. | 5 pcs | 1:5 |
| 2 | Charts | Visual aids covering engine and safety protocols | 10 pcs | 1:2.5 |
| 3 | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
| 1 | Lecture/Theory Room | Equipped with projectors and seating for 25 trainees, ~60 sqm | 1 | 1:25 |
| 2 | Workshop | Hands-on training area with workbenches, tools, and safety equipment, ~80 sqm | 1 | 1:25 |
| 3 | Computer Laboratory | Equipped with internet access | 5 | 1:5 |
|  |  |  |  |  |
| **C** | **Consumable Materials** |  |  |  |
|  | First aid kit |  | 5 pieces | 1:5 |
|  | Lubricating oil | For replacing during overhaul | 10 litres | 2:5 |
|  | Petrol fuel | For testing and running engine | 10 litres | 2:5 |
|  | Paraffin | For cleaning components during overhaul | 10 litres | 2:5 |
|  | Anti rust solution | For cleaning rusted parts | 5 pcs | 1:5 |
|  | Cotton waste | For cleaning components | 1 bag |  |
|  | Valve grinding paste | For grinding valves | 10 pieces | 2:5 |
|  | Oil filter | For replacement during service | 2 |  |
|  | Fuel filter | For replacement during service | 2 |  |
|  | Air filters | For replacement during service | 2 |  |
|  | Coolant | For replacement during service | 10 litres | 2:5 |
| **D** | **Tools and Equipment** |  |  |  |
|  | Petrol vehicle | For servicing engine | 1 | 1:25 |
|  | Petrol engines | For overhauling | 5 | 1:5 |
|  | Complete combination cabinet toolbox | Assorted sets for various applications | 5 cabinets | 1:5 |
|  | Engine stand | For mounting engines | 10 | 2:5 |
|  | Trolley jacks | For lifting engines | 2 | 1:13 |
|  | Valve spring compressors | For removing engine valves | 5 | 1:5 |
|  | Piston ring squeezers | For fitting piston rings | 5 | 1:5 |
|  | Cooling system test kit | For testing cooling system components | 2 | 1:13 |
|  | Petrol engine compression gauge | For testing | 1 | 1:25 |
|  | Cylinder bore gauge | For testing | 2 sets | 1:13 |
|  | Vacuum gauge | For testing engine vacuum | 2 | 1:13 |
|  | Air compressor | For compressed air supply | 1 | 1:25 |
|  | Multimeter | For testing | 5 | 1:25 |
|  | OBD II scanner | For diagnosis | 5 | 1:25 |
|  | Hydraulic press | For pressing | 1 | 1:25 |
|  | Injector testing machine | For testing injection pressure | 1 | 1:25 |
|  | Spark plug testing machine | For testing spark plug functionality | 1 | 1:25 |
|  | Work tables with vices |  | 5 | 1:5 |
|  | Dust bin | For dust collecting | 3 | 1:9 |
|  | Waste oil tank | For collecting waste oil | 1 | 1:25 |
| **E** | **PPE (Personal Protective Equipment)** |  |  |  |
| 1 | PPE Sets | Includes gloves, safety boot, and overall/ dust bin | 25 sets | 1:1 |
| 2 | Safety Signs and Barriers | For simulating safety zones and hazards | 10 sets | 1:2.5 |
| 3 | Wheel chokes | For choking wheels while servicing | 8 pieces | 1:3 |
| **F** | **Reference Materials** |  |  |  |
| 1 | Engine manuals | Covering principles and practices in automation | 25 pcs | 1:1 |
| 3 | Technical Handbooks | On vehicle engine service | 25 pcs | 1:1 |
| 4 | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
| 5 | Multimedia Learning Modules | Digital licenses for videos and tutorials | 25 pcs | 1:1 |
| 6 | Practical Assessment Guides | Worksheets for practical assessments | 25 pcs | 1:1 |

# VEHICLE BRAKING SYSTEM MAINTENANCE

**UNIT CODE: 0716 251 02A**

**UNIT DURATION:** 100 Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Maintain vehicle-braking system.

**Unit Description**

This unit specifies competencies required to Maintain Vehicle Braking system. It involves Assessing vehicle braking system, servicing vehicle braking system and performing house keeping

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Assess vehicle-braking system | 10 |
|  | Service vehicle braking system | 30 |
|  | Perform braking system diagnostics | 50 |
|  | Perform House keeping | 10 |
|  | | 100 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Assess vehicle braking system | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures   2. Braking system construction and operation      1. Hydraulic brakes         1. Drum brake         2. Disc brake   3. Braking system inspection      1. Brake fluid level      2. Fluid Leakages      3. Brake pads      4. Brake lines and hoses      5. Brake pedal feel and operation tests   4. Braking system service/replacement      1. Brake fluid top up      2. Brake bleeding |  |
| * Practical * Project * Portfolio of evidence * Third party report * Written tests. * Oral questioning |
| 1. Service vehicle braking system | * 1. Braking system service safety measures      1. Vehicle safety precautions      2. Tool safety      3. Work area safety      4. Handling braking components   2. Braking system Tools, equipment and materials      1. Uses and maintenance   3. Braking system dismantling procedure      1. Drum brake      2. Disc brake   4. Braking system components inspection      1. Wear      2. Cracks      3. Rust      4. Bends      5. Spring tension   5. Braking system components service/replacement      1. Brake pads replacement      2. Brake drum and shoe replacement      3. Master cylinder      4. Brake line and hose   6. Braking system components assembly      1. Assembly procedure      2. Brake adjustments      3. Brake bleeding   7. Braking system test      1. Brake fluid level      2. Leak test      3. Brake pedal feel test | * Practical * Project * Portfolio of evidence * Third party report * Written tests. * Oral questioning |
| 1. Perform braking system diagnostics | * 1. Brake system diagnosis safety measures      1. Personal protecting equipment      2. Vehicle safety precaution      3. Handling brake fluid      4. Tool safety      5. Work area organisation      6. Vehicle testing procedure      7. Emergency procedures   2. Common braking system faults and remedies      1. Worn out brake pads/shoes      2. Brake fluid leakage      3. ABS faults   3. Common diagnostic techniques      1. Listening for noises      2. Brake drag check | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |
| 1. Perform housekeeping | * 1. Housekeeping      1. Definition      2. Importances   2. Work area preparation      1. Preparing tools and equipment      2. Setting up workplace      3. Cleaning during and after work   3. Handling brake fluids and hazardous materials      1. Types of engine fluids      2. Safe handling and disposal      3. Personal protective equipment   4. Waste management      1. Types of waste in engine maintenance      2. Waste segregation      3. Recycling and environmental responsibility | * Practical * Project * Portfolio of evidence * Third party report * Written tests * Oral questioning |

**Suggested Methods of Instruction**

* + Demonstrations
  + Practical
  + Projects
  + Group Discussion
  + Direct instructions

The delivery may also be supplimented and enhanced by the following , if the opportunity allows;

* Visiting lecturer/trainer from the motor vehicle service and repair sector
* Industrial visit

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
| 1 | Textbooks | Comprehensive texts on braking service. | 5 pcs | 1:5 |
| 2 | Charts | Visual aids covering braking and safety protocols | 10 pcs | 1:2.5 |
| 3 | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
| 1 | Lecture/Theory Room | Equipped with projectors and seating for 25 trainees, ~60 sqm | 1 | 1:25 |
| 2 | Workshop | Hands-on training area with workbenches, tools, and safety equipment, ~80 sqm | 1 | 1:25 |
| 3 | Computer Laboratory | Equipped with internet access | 5 | 1:5 |
|  |  |  |  |  |
| **C** | **Consumable Materials** |  |  |  |
|  | First aid kit |  | 5 pieces | 1:5 |
|  | Brake fluid | For replacing during service | 10 litres | 2:5 |
|  | Paraffin | For cleaning components during overhaul | 10 litres | 2:5 |
|  | Anti rust solution | For cleaning rusted parts | 5 pcs | 1:5 |
|  | Cotton waste | For cleaning components | 1 bag |  |
|  |  |  |  |  |
| **D** | **Tools and Equipment** |  |  |  |
|  | Vehicle fitted with drum brakes | For servicing drum brakes | 1 | 1:25 |
|  | Vehicle fitted with disc brakes | For servicing disc brakes | 1 | 1:25 |
|  | Vehicle fitted with air brakes | For servicing drum brakes | 1 | 1:25 |
|  | Disc/drum brakes model | For servicing | 1 | 1:25 |
|  | Compressed air brakes model | For servicing | 1 | 1:25 |
|  | Complete combination cabinet toolbox | Assorted sets for various applications | 5 cabinets | 1:5 |
|  | Trolley jacks | For lifting the vehicle | 2 | 1:13 |
|  | Brake decelerometer | For testing brake efficiency | 1 | 1:25 |
|  | Brake Dynamometer | For testing brake efficiency | 1 | 1:25 |
| **E** | **PPE (Personal Protective Equipment)** |  |  |  |
| 1 | PPE Sets | Includes gloves, safety boot, and overall/ dust bin | 25 sets | 1:1 |
| 2 | Safety Signs and Barriers | For simulating safety zones and hazards | 10 sets | 1:2.5 |
| 3 | Wheel chokes | For choking wheels while servicing | 8 pieces | 1:3 |
| **F** | **Reference Materials** |  |  |  |
| 1 | vehicle manuals | Covering principles and practices in braking system | 25 pcs | 1:1 |
| 3 | Technical Handbooks | On vehicle brake service | 25 pcs | 1:1 |
| 4 | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
| 5 | Multimedia Learning Modules | Digital licenses for videos and tutorials | 25 pcs | 1:1 |
| 6 | Practical Assessment Guides | Worksheets for practical assessments | 25 pcs | 1:1 |

**MODULE II**

# **VEHICLE DIESEL ENGINE MAINTENANCE**

**UNIT CODE: 0716 351 03A**

**UNIT DURATION:** 180Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Maintain Vehicle Diesel Engine.

**Unit Description**

This unit specifies competencies required to service and repair vehicle Diesel engine. It involves performing vehicle diesel engine overhaul, servicing vehicle diesel engine cooling system, service vehicle diesel engine fuel system and service vehicle diesel engine lubricating system.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Perform diesel engine overhaul | 80 |
|  | Service vehicle diesel engine cooling system | 30 |
|  | Service vehicle diesel engine lubrication system | 30 |
|  | Service Vehicle engine diesel Fuel system | 40 |
| TOTAL | | 180 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Perform Vehicle diesel engine overhaul | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures      4. Housekeeping practices      5. Waste disposal   2. Engine classification      1. Operating cycles         1. 4 stroke cycle diesel engine      2. Valve arrangements         1. Overhead valve         2. Overhead camshaft         3. Double overhead camshaft      3. Engine configuration         1. Inline         2. V-configuration   3. Engine construction      1. Engine components and their functions         1. Cylinder head components         2. Engine block components         3. Valve assembly components         4. Exhaust components         5. Cooling components         6. Lubrication components   4. Diesel Engine Diagnosis and remedies      1. Fuel system      2. Ignition system      3. Air intake and exhaust system      4. Cooling system   5. Diesel Engine Overhaul tools, equipment and materials      1. Uses and maintenance practices         1. Assorted tools         2. Torque wrench         3. Engine stand         4. Ring compressor         5. Feeler gauge         6. Valve spring compressor         7. Micrometre         8. Dial gauge         9. Compression tester   6. Engine Dismantling      1. Purpose for dismantling      2. Dismantling procedure      3. Cleaning parts   7. Engine parts inspection      1. Leak detection      2. Crack detection      3. Measurements      4. Warping   8. Engine parts service/replacement      1. Cylinder block and cylinder walls      2. Piston and piston rings      3. Crankshaft and bearing      4. Cylinder head and valves      5. Connecting rod      6. Camshaft and timing components      7. Gasket and seals   9. Engine parts assembly      1. Assembly procedure      2. Timing      3. Engine tune up   10. Engine fitting and mounting       1. Fitting procedure       2. Engine mounting   11. Re installation check       1. Visual checks       2. Fluid checks       3. Alignment and clearance checks       4. Exhaust system checks       5. Cooling system checks       6. Fuel system pressure check |  |
| * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Service vehicle diesel engine cooling system | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures      4. Housekeeping practices      5. Waste disposal   2. Vehicle cooling system      1. Purpose and importance      2. Components of cooling system and their functions      3. Cooling system operation   3. Types of cooling system      1. Liquid cooling systems   4. Engine cooling system diagnosis and remedies      1. Low coolant      2. Overheating      3. Heater malfunction      4. Coolant contamination      5. Abnormal noises      6. Radiator fan failure   5. Cooling system tools, equipment and materials      1. Uses and maintenance   6. Cooling system inspection      1. Radiator cap      2. Radiator      3. Hoses      4. Water pump      5. Thermostat      6. Cooling fan      7. Sensor   7. Engine cooling system service/replacement      1. Fan belt      2. Thermostat      3. Radiator      4. Pressure cap      5. Coolant      6. Hoses      7. Water pump   8. Cooling system parts installation      1. Parts installation      2. Bleeding      3. Operation testing | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Service vehicle diesel engine lubrication system | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures      4. Housekeeping practices      5. Waste disposal   2. Lubrication system      1. Functions      2. Lubrication system construction and operation      3. Types of lubricants   3. Filtration methods      1. Full flow      2. By pass   4. Types of lubrication system      1. Wet sump      2. Force feed      3. Dry sump   5. Engine lubrication system diagnosis and remedies      1. Low oil pressure      2. Excessive oil consumption      3. Oil leaks      4. Oil contamination   6. Engine lubrication system service tools, equipment and materials      1. Uses and maintenance   7. Engine lubrication system inspection      1. Leakage      2. Oil pump operation      3. Oil levels      4. Oil seals      5. Oil filter   8. Engine lubrication system service/replacement      1. Leakage      2. Oil pump operation      3. Lubricating oil      4. Oil seals      5. Oil filter      6. Gaskets   9. Lubrication system parts installation      1. Components fitting      2. Reinstallation checks   10. Lubrication system operation tests       1. Oil pressure test       2. Leak inspection       3. Oil level check | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Service Vehicle diesel engine Fuel system | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures      4. Housekeeping practices      5. Waste disposal   2. Fuel system operation      1. Diesel fuel system   3. Diesel injection systems      1. Direct injection      2. Indirect injection   4. Fuel system service tools and equipment      1. Uses and maintenance practices   5. Fuel system diagnosis and remedies      1. Short circuit      2. Open circuits   6. Fuel system inspection      1. Serviceability      2. Leakages      3. Clogging      4. Spray pattern   7. Fuel system components service/replacement      1. Fuel filter      2. Fuel injector      3. Fuel pump      4. Blockage      5. Injector nozzles   8. Fuel system re installation checks      1. Fuel lines      2. Pressure check      3. Injector functionality      4. Leak checks   9. Fuel system service documentation      1. Customer details and vehicle details   10. Over view of fuel system condition and service report | * Practical * Project * Portfolio of evidence * Third party report * Written tests |

**Suggested Methods of Instruction**

* + Demonstrations
  + Practical
  + Projects
  + Group Discussion
  + Direct instructions

The delivery may also be supplimented and enhanced by the following , if the opportunity allows;

* Visiting lecturer/trainer from the motor vehicle service and repair sector
  + Industrial visits

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
| 1 | Textbooks | Comprehensive texts on engine service. | 5 pcs | 1:5 |
| 2 | Charts | Visual aids covering engine and safety protocols | 10 pcs | 1:2.5 |
| 3 | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
| 1 | Lecture/Theory Room | Equipped with projectors and seating for 25 trainees, ~60 sqm | 1 | 1:25 |
| 2 | Workshop | Hands-on training area with workbenches, tools, and safety equipment, ~80 sqm | 1 | 1:25 |
| 3 | Computer Laboratory | Equipped with internet access | 5 | 1:5 |
| **C** | **Consumable Materials** |  |  |  |
|  | First aid kit |  | 5 pieces | 1:5 |
|  | Lubricating oil | For replacing during overhaul | 10 litres | 2:5 |
|  | Petrol fuel | For cleaning purposes | 5 litres | 2:5 |
|  | diesel fuel | For testing and running engine | 10 litres | 2:5 |
|  | Paraffin | For cleaning components during overhaul | 10 litres | 2:5 |
|  | Anti rust solution | For cleaning rusted parts | 5 pcs | 1:5 |
|  | Cotton waste | For cleaning components | 1 bag |  |
|  | Valve grinding paste | For grinding valves | 10 pieces | 2:5 |
|  | Oil filter | For replacement during service | 5 | 1:5 |
|  | Fuel filter | For replacement during service | 5 | 1:5 |
|  | Air filters | For replacement during service | 5 | 1:5 |
|  | Coolant | For replacement during service | 5 litres | 2:5 |
| **D** | **Tools and Equipment** |  |  |  |
|  | Diesel vehicle | For servicing engine | 1 | 1:25 |
|  | Diesel engines | For overhauling | 5 | 1:5 |
|  | Complete combination cabinet toolbox | Assorted sets for various applications | 5 cabinets | 1:5 |
|  | Engine stand | For mounting engines | 10 | 2:5 |
|  | Trolley jacks | For lifting engines | 2 | 1:13 |
|  | Valve spring compressors | For removing engine valves | 5 | 1:5 |
|  | Piston ring squeezers | For fitting piston rings | 5 | 1:5 |
|  | Cooling system test kit | For testing cooling system components | 2 | 1:13 |
|  | Diesel engine compression gauge | For testing | 1 | 1:25 |
|  | Cylinder bore gauge | For testing | 2 sets | 1:13 |
|  | Vacuum gauge | For testing engine vacuum | 2 | 1:13 |
|  | Air compressor | For compressed air supply | 1 | 1:25 |
|  | Multimeter | For testing | 5 | 1:25 |
|  | OBD II scanner | For diagnosis | 5 | 1:25 |
|  | Hydraulic press | For pressing | 1 | 1:25 |
|  | Diesel pump Calibration machine | For testing phasing and calibration | 1 | 1:25 |
|  | Injector testing machine | For testing injection pressure | 1 | 1:25 |
|  | Work tables with vices |  | 5 | 1:5 |
|  | Dust bin | For dust collecting | 3 | 1:9 |
|  | Waste oil tank | For collecting waste oil | 1 | 1:25 |
| **E** | **PPE (Personal Protective Equipment)** |  |  |  |
| 1 | PPE Sets | Includes gloves, safety boot, and overall/ dust bin | 25 sets | 1:1 |
| 2 | Safety Signs and Barriers | For simulating safety zones and hazards | 10 sets | 1:2.5 |
| 3 | Wheel chokes | For choking wheels while servicing | 8 pieces | 1:3 |
| **F** | **Reference Materials** |  |  |  |
| 1 | Engine manuals | Covering principles and practices in automation | 25 pcs | 1:1 |
| 3 | Technical Handbooks | On vehicle engine service | 25 pcs | 1:1 |
| 4 | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
| 5 | Multimedia Learning Modules | Digital licenses for videos and tutorials | 25 pcs | 1:1 |
| 6 | Practical Assessment Guides | Worksheets for practical assessments | 25 pcs | 1:1 |

# **VEHICLE SUSPENSION AND STEERING SYSTEM MAINTENANCE**

**UNIT CODE: 0716 351 04A**

**UNIT DURATION: 160** Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: service motor vehicle steering system and wheels

**Unit Description**

This unit specifies competencies required to service vehicle suspension system, Service vehicle steering system, Service vehicle wheels and tyres and carry out vehicle wheel alignment

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Vehicle Suspension and Steering System Diagnosis | 20 |
|  | Vehicle Suspension System | 50 |
|  | Vehicle Steering System | 40 |
|  | Vehicle Wheels and Tyres | 30 |
|  | Vehicle Wheel Alignment | 20 |
| TOTAL | | 160 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Service vehicle suspension system | * 1. Suspension service safety measures      1. Personal protective equipment      2. Vehicle lifting and supporting      3. Handling suspension springs and shock absorbers      4. Tools and equipment safety      5. Waste disposal   2. Suspension system construction and operation      1. Suspension system components      2. Principles of operation   3. Types of suspension system      1. Non independent suspension      2. Independent Front and rear suspensions      3. Hydrolastic      4. Hydra gas      5. Hydro pneumatic      6. Air suspension   4. Suspension system components diagnosis      1. Springs      2. Shock absorbers      3. Control arm bushings      4. Ball joints      5. Stabilizer links      6. Alignment and geometry      7. Torsion bars      8. Air Suspension system leaks   5. Tools, equipment and materials required      1. Uses and maintenance   6. Suspension system components inspection      1. Serviceability      2. Tolerances      3. Leakage      4. Wear      5. Corrosion      6. Damage   7. Suspension system components cleaning, service/replacement and assembly      1. Seals      2. Shims      3. Fittings      4. Fasteners      5. Bushes      6. Springs   8. Suspension system reinstallation checks      1. Alignment      2. Torque specification      3. Spring and shock absorber position      4. Bush and joints inspection      5. Performance checks and adjustments   9. Suspension system service documentation      1. Overview of suspension system condition and service | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |
| 1. Service vehicle steering system | * 1. Steering system service safety measures      1. Handling steering components   2. Steering system construction and operation      1. Steering system components      2. Principles of operation      3. Functions of steering system   3. Steering geometry      1. Ackerman’s principle      2. Camber      3. Castor      4. Ton in toe out   4. Steering system gearboxes      1. Rack and pinion      2. Recirculating ball      3. Worm and sector      4. Screw and nut      5. Worm and roller      6. Cam and peg   5. Types of steering systems      1. Conventional      2. Twin-axle   6. Power steering      1. Electric power assisted      2. Hydraulic Power assisted steering   7. Steering system diagnosis      1. Car pulls to one side      2. Vibration      3. Car wanders      4. Uneven tire wear   8. Steering system diagnosis, inspection and dismantling.      1. Tolerances      2. Leakage      3. Wear      4. Corrosion      5. Damage      6. Fluid checks   9. Steering system components service/replacement and adjustments      1. Steering rack      2. Steering gearboxes      3. Drag link      4. Drop arm      5. Track rods      6. Track arm   10. Steering system assembly and testing       1. Assembly procedure       2. Alignment and final   11. System service documentation       1. Overview of steering system condition and service | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |
| 1. Service vehicle wheels and tires | * 1. Wheel and tyre construction and operation      1. Wheel construction      2. Tire components   2. Types of wheels.      1. Aluminium      2. Steel      3. Wire spoke   Wheel construction   * + 1. Flat base     2. Well base     3. Divided     4. Single piece     5. Two pieces     6. Three pieces   1. Types of tires      1. Tubed      2. Tubeless      3. Run flat      4. Non pneumatic tires      5. Sensor equipped tires      6. Self-sealing tires   2. Tire classification      1. Cross ply      2. Radial ply   3. Tire construction      1. Beads      2. Carcass      3. Sidewall      4. Tread      5. Inner liner   4. Tyre specification      1. Pressure rating      2. Aspect ratio      3. Width      4. Diameter      5. Speed      6. Load carrying capacity   5. Tubes      1. Sizes      2. Nozzles      3. Coding   6. Tools and equipment uses and maintenance      1. Digital wheel      2. balancing machine      3. Tread depth gauge      4. Tire bead breaker.      5. Tire levers.      6. Tire valve key.      7. Vulcanising machine.      8. Tubeless tire repair kit.   7. Wheels and tyres inspection and checks      1. Tyre condition      2. Tread wear pattern      3. Side wall inspection      4. Tyre pressure check      5. Wheel condition check      6. Wheel and tyre balancing check      7. Wheel alignment check      8. Tread wear marks   8. Repair and maintenance      1. Tyre puncture repair      2. Wheel balancing      3. Wheel rotation | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |
| 1. Carry out vehicle wheel alignment | * 1. Wheel alignment      1. Definition of terms      2. Importance of wheel alignment      3. Wheel alignment angles   2. Diagnosis of misalignment      1. Common signs of wear      2. Diagnosing misalignment   3. Tools, equipment and materials uses and maintenance      1. Optical gauge wheel alignment equipment      2. Computerised wheel alignment machine (3D)   4. Wheel alignment procedure      1. Pre alignment checklist      2. Safety protocols      3. Alignment angles adjustment      4. Final testing   5. Wheel alignment documentation      1. Overview of wheel alignment | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |

**Suggested Methods of Instruction**

* + Demonstrations
  + Practical
  + Projects
  + Group Discussion
  + Direct instructions

The delivery may also be supplimented and enhanced by the following , if the opportunity allows;

* Visiting lecturer/trainer from the motor vehicle service and repair sector
* Industrial visits

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
| 1 | Textbooks | Comprehensive texts on suspension and steering service. | 5 pcs | 1:5 |
| 2 | Charts | Visual aids covering braking and safety protocols | 10 pcs | 1:2.5 |
| 3 | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
| 1 | Lecture/Theory Room | Equipped with projectors and seating for 25 trainees, ~60 sqm | 1 | 1:25 |
| 2 | Workshop | Hands-on training area with workbenches, tools, and safety equipment, ~80 sqm | 1 | 1:25 |
| 3 | Computer Laboratory | Equipped with internet access | 5 | 1:5 |
|  |  |  |  |  |
| **C** | **Consumable Materials** |  |  |  |
|  | First aid kit |  | 5 pieces | 1:5 |
|  | Steering hydraulic fluid | For replacing during service | 10 litres | 2:5 |
|  | Paraffin | For cleaning components during overhaul | 10 litres | 2:5 |
|  | Anti rust solution | For cleaning rusted parts | 5 pcs | 1:5 |
|  | Cotton waste | For cleaning components | 1 bag |  |
|  | Assorted tube and tubeless patches | For repairing slow puncture | 50 pieces | 2:1 |
|  |  |  |  |  |
| **D** | **Tools and Equipment** |  |  |  |
|  | Vehicle fitted with non-independent suspension system with complete steering system and wheels | For servicing suspension system, steering and wheels | 1 | 1:25 |
|  | Vehicle fitted with independent suspension system with complete steering system and wheels | For servicing suspension system, steering and wheels | 1 | 1:25 |
|  | Complete steering and suspension model | For demonstrations | 1 | 1:25 |
|  | Complete combination cabinet toolbox | Assorted sets for various applications | 5 cabinets | 1:5 |
|  | Trolley jacks | For lifting the vehicle | 2 | 1:13 |
|  | Manual wheel alignment gauge (don lope type) | For checking alignment | 1 | 1:25 |
|  | Digital wheel alignment equipment | For checking alignment | 1 | 1:25 |
|  | Wheel balancing machine | For balancing wheels | 1 | 1:25 |
|  | Tire changer machine | For separating tire and rim | 1 | 1:25 |
|  | Coil spring compressor | For removing coil spring | 1 | 1:25 |
|  | Hydraulic press | Removing bushes and bearings | 1 | 1:25 |
|  | Air compressor | For inflating tire | 1 | 1:25 |
|  | Tire repair kit | For repairing tires | 5 | 1:5 |
| **E** | **Personal Protective Equipment (PPE)** |  |  |  |
| 1 | PPE Sets | Includes gloves, safety boot, and overall/ dust bin | 25 sets | 1:1 |
| 2 | Safety Signs and Barriers | For simulating safety zones and hazards | 10 sets | 1:2.5 |
| 3 | Wheel chokes | For choking wheels while servicing | 8 pieces | 1:3 |
| **F** | **Reference Materials** |  |  |  |
|  | Vehicle manuals | Covering principles and practices in vehicle suspension and steering system | 25 pcs | 1:1 |
|  | Technical Handbooks | On vehicle suspension and steering service | 25 pcs | 1:1 |
|  | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
|  | Multimedia Learning Modules | Digital licenses for videos and tutorials | 25 pcs | 1:1 |
|  | Practical Assessment Guides | Worksheets for practical assessments | 25 pcs | 1:1 |

# MODULE III

# BASIC UNITS OF LEARNING

# **COMMUNICATION SKILLS**

**ISCED UNIT CODE:** **0031 441 05A**

**Relationship with Occupational Standards**

This unit addresses the Unit of Competency: Apply Communication Skills

**Duration of Unit:** **40 Hours**

**Unit Description**

This unit covers the competencies required to apply communication skills. It involves applying communication channels, written, non-verbal, oral, and group communication skills.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Apply communication channels. | 10 |
|  | Apply written communication skills. | 12 |
|  | Apply non-verbal skills. | 4 |
|  | Apply oral communication skills. | 4 |
|  | Apply group communication skills. | 10 |
|  | | 40 |

**Learning Outcomes, Content, and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply communication channels | * 1. Communication process   2. Principles of effective communication   3. Channels/medium/modes of communication   4. Factors to consider when selecting a channel of communication   5. Barriers to effective communication   6. Flow/patterns of communication   7. Sources of information   8. Organizational policies | * Oral questions * Written assessment * Observation * Portfolio of Evidence * Practical assessment * Third party report |
| 1. Apply written communication skills | * 1. Types of written communication   2. Elements of communication   3. Organization requirements for written communication | * Oral assessment * Written assessment * Observation * Portfolio of Evidence * Practical assessment * Third party report |
| 1. Apply non-verbal communication skills | * 1. Utilize body language and gestures   2. Apply body posture   3. Apply workplace dressing code | * Oral assessment * Written assessment * Observation * Portfolio of Evidence * Practical assessment * Third party report |
| 1. Apply oral communication skills | * 1. Types of oral communication pathways   2. Effective questioning techniques   3. Workplace etiquette   4. Active listening | * Oral assessment * Written assessment * Observation * Portfolio of Evidence * Practical assessment * Third party report |
| 1. Apply group discussion skills | * 1. Establishing rapport      1. Facilitating resolution of issues      2. Developing action plans      3. Group organization techniques      4. Turn-taking techniques      5. Conflict resolution techniques      6. Team-work | * Oral assessment * Written assessment * Observation * Portfolio of Evidence * Practical assessment |

**Suggested Methods of Instruction**

* Discussion
* Roleplaying
* Simulation
* Direct instruction
* Demonstration
* Field trips

**Recommended Resources for 30 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
|  | Textbooks | Comprehensive texts books on Communication Skills | 30 pcs | 1:1 |
|  | Mobile Phones | Smartphone for use by trainees | 30 pcs | 1:1 |
|  | Internet connection | Internet connection to aid communication between trainees |  |  |
|  | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:30 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:30 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:30 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:30 |
|  | Templates | Templates for creating various documents e.g. CV, Cover Letter, minutes, reports etc. | 30 | 1:1 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
|  | Lecture/Theory Room  /Learning Resource  Area\* | Spacious, equipped with projectors and Seats for 30 trainees, approximately 45 sqm (5 m x 9 m) | 1 | 1:30 |
|  | Computer Laboratory | Equipped with at least 30 functional computers with internet connectivity and the following software:   * + - Windows/ Linux/ Macintosh Operating System     - Microsoft Office Software     - Google Workspace Account     - Antivirus Software | 30 | 1:1 |
| **C** | **Consumable Materials** |  |  |  |
|  | Printing Papers | A4 and A3 Printing papers suitable for the task | Enough |  |
|  | Flashcards | For carrying out various activities by trainees | Enough |  |
|  | Flipcharts | Sufficient for group work activities and displaying | Enough |  |
|  | Whiteboard Marker Pens | Dry-erase markers for trainers use. Assorted colors | Enough |  |

# **WORK ETHICS AND PRACTICES**

**ISCED UNIT CODE:** **0417 441 06A**

**Relationship with Occupational Standards**

This unit addresses the Unit of Competency: Apply work ethics and practices.

**Duration of Unit: 40 Hours**

**Unit Description**

This unit covers competencies required to demonstrate employability skills. It involves the ability to: conduct self-management, promote ethical work practices and values, promote teamwork, manage workplace conflicts, maintain professional and personal development, apply problem-solving, and promote customer care.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Apply self-management skills | 10 |
|  | Promote ethical practices and values | 4 |
|  | Promote Teamwork | 10 |
|  | Maintain professional and personal development | 10 |
|  | Apply Problem-solving skills | 4 |
|  | Promote Customer care. | 2 |
|  | | 40 |

**Learning Outcomes, Content, and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply self-management skills | * 1. Self-awareness   2. Formulating personal vision, mission, and goals   3. Healthy lifestyle practices   4. Strategies for overcoming work challenges   5. Emotional intelligence   6. Coping with Work Stress.   7. Assertiveness versus aggressiveness and passiveness      1. Developing and maintaining high self-esteem      2. Developing and maintaining positive self-image      3. Time management      4. Setting performance targets      5. Monitoring and evaluating performance targets | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |
| 1. Promote ethical work practices and values | * 1. Integrity   2. Core Values, ethics and beliefs   3. Patriotism   4. Professionalism   5. Organizational codes of conduct   6. Industry policies and procedures | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |
| 1. Promote Teamwork | * 1. Types of teams   2. Team building      1. Individual responsibilities in a team      2. Determination of team roles and objectives      3. Team parameters and relationships      4. Benefits of teamwork      5. Qualities of a team player      6. Leading a team      7. Team performance and evaluation   3. Conflicts and conflict resolution   4. Gender and diversity mainstreaming   5. Developing Healthy workplace relationships   6. Adaptability and flexibility   7. Coaching and mentoring skills | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |
| 1. Maintain professional and personal development | * 1. Personal vs professional development and growth   2. Avenues for professional growth   3. Recognizing career advancement   4. Training and career opportunities      1. Assessing training needs      2. Mobilizing training resources   5. Licenses and certifications for professional growth and development   6. Pursuing personal and organizational goals   7. Managing work priorities and commitments   8. Dynamism and on-the-job learning | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |
| 1. Apply Problem-solving skills | * 1. Causes of problems   2. Methods of solving problems   3. Problem-solving process   4. Decision making   5. Creative thinking and critical thinking process in development of innovative and practical solutions | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |
| 1. Promote Customer Care | * 1. Identifying customer needs   2. Qualities of good customer service   3. Customer feedback methods   4. Resolving customer concerns   5. Customer outreach programs   6. Customer retention | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |

**Suggested Methods of Instruction**

* Instructor lead facilitation of theory using active learning strategies.
* Demonstrations
* Simulation/Role play
* Group Discussion
* Presentations
* Projects
* Case studies
* Assignments

**Recommended Resources for 30 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
|  | Textbooks | Comprehensive texts books on Work Ethics and Practices | 30 pcs | 1:1 |
|  | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:30 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:30 |
|  | Media Resources | This include but are not limited to:   * Video Clips * Audio Clips * TV Sets * Radio Sets |  |  |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:30 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
|  | Lecture/Theory Room  /Learning Resource  Area\* | Spacious, equipped with projectors and Seats for 30 trainees, approximately 45 sqm (5 m x 9 m) | 1 | 1:30 |
|  | Computer Laboratory | Equipped with at least 30 functional computers with internet connectivity and the following software:   * + - Windows/ Linux/ Macintosh Operating System     - Microsoft Office Software     - Google Workspace Account     - Antivirus Software | 30 | 1:1 |
|  |  |  |  |  |
| **C** | **Consumable Materials** |  |  |  |
|  | Printing Papers | A4 and A3 Printing papers suitable for the task | Enough |  |
|  | Flashcards | For carrying out various activities by trainees | Enough |  |
|  | Charts | Sufficient for group work activities and displaying | Enough |  |
|  | Whiteboard Marker Pens | Dry-erase markers for trainers use. Assorted colors | Enough |  |

# COMMON UNITS OF LEARNING

# **APPLIED MATHEMATICS**

**Unit Code: 0541 441 07A**

**Relationship with Occupational Standards**

This unit addresses the Unit of Competency: Apply Mathematics

**Unit Duration: 80 Hours**

**Unit Description**

This unit describes the competences required in order to Apply trigonometric functions, carrying out mensuration, Apply statistics and probability

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Apply algebra | 20 |
|  | Apply trigonometric functions | 20 |
|  | Carry out mensuration | 20 |
|  | Apply statistics and probability | 20 |
|  | | 80 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + - 1. Apply algebra | * 1. Indices      1. Power zero      2. Negative powers      3. Fractional powers      4. Laws of indices         1. Addition         2. Subtraction         3. Division         4. Multiplication   2. BODMAS   3. Roots      1. Square roots      2. Cube roots      3. nth roots   4. Logarithms      1. Laws of Logarithms         1. Product Law         2. Quotient Law         3. Power Law   5. Use of scientific calculator      1. Power ON/OFF      2. Mode         1. Degree         2. Radian         3. Gradient         4. SD      3. Clear      4. Save      5. Shift   6. Simultaneous equations   (up to 3 equations)   * + 1. Elimination     2. Substitution     3. Reduction     4. Graphical   1. Quadratic equations      1. Factorization      2. Quadratic formula      3. Completing the square      4. Graphical | * Written tests |
| * + - 1. Apply trigonometric functions | * 1. Angles      1. Acute      2. Obtuse      3. Reflex      4. Right angle   2. Triangles      1. Isosceles      2. Equilateral      3. Right angled      4. Scalene   3. Trigonometric Ratios      1. Sine      2. Cosine      3. Tangent      4. Cosecant      5. Secant      6. Cotangent   4. Trigonometric Identities      1. Proof of identities      2. Pythagorean identities   5. Solve trigonometric equations   6. Hyperbolic functions      1. Sinh x      2. Cosh x      3. Cosech x      4. Tanh x      5. Sech x | * Written tests |
| 1. Carry out mensuration | * 1. Units and symbols of measurement      1. Mass      2. Distance      3. Speed      4. Temperature      5. Time   2. Imperial and metric units      1. Conversions   3. Perimeter      1. Regular shapes   4. Area      1. Regular shapes   5. Volume      1. Regular shapes | * Written tests |
| 1. Apply statistics and probability | * 1. Data presentation      1. Continuous variables         1. Histogram         2. Line      2. Discrete variable         1. Bar graph         2. Pie graph      3. Grouped data         1. Histogram         2. Bar         3. Cumulative frequency         4. ogive      4. Ungrouped data         1. Line         2. Cumulative frequency   2. Measures of central tendency      1. Mean         1. Grouped data         2. Ungrouped data      2. Mode         1. Grouped data         2. Ungrouped data      3. Medium         1. Grouped data         2. Ungrouped data   3. Measures of dispersion      1. Standard deviation         1. Grouped data         2. Ungrouped data      2. Variance         1. Grouped data         2. Ungrouped data   4. Probability      1. With replacement      2. Without replacement   5. Probability distribution functions      1. Binomial distribution      2. Poisson distribution   6. Normal distribution | * Written tests |

**Suggested Delivery Methods**

* Demonstration
* Group discussions
* Exercises
* Online materials
* Direct instructions
* Simulation

**Recommended Resources for 30 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** | | | |
|  | Textbooks | Comprehensive textbooks on Engineering Mathematics | 30 | 1:1 |
|  | Graph books | For graphical representation of solutions | 30 | 1:1 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:30 |
|  | Computer | Functional desktop computer with online instructional content | 1 | 1:30 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:30 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:30 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Spacious room with seats for 25 trainees, approximately 60 sqm | 1 | 1:30 |
| **C** | **Materials and Supplies** | | | |
|  | First Aid kit | Fully equipped First Aid kit for use in case of accidents | 1 | 1:30 |
| **D** | **Tools and Equipment** | | | |
|  | Set of Mathematical instruments | For constructions and measurements | 30 | 1:1 |
|  | Scientific Calculator | For Calculations | 30 | 1:1 |
|  | Firefighting extinguishers | Water, carbon dioxide and chemical powder fire extinguishers for fire fighting | 1 | 1:30 |
| **E** | **Reference Materials** | | | |
|  | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:30 |
|  | Standard Mathematical Tables | For reference on formulae, identities, laws and principles | 30 | 1:1 |

# **TECHNICAL DRAWING**

**UNIT CODE: 0732 451 08A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply technical drawings

**Duration of Unit:** 80 Hours

**Unit Description**

This unit covers the competences required to apply technical drawings. It involves using technical drawing tools, equipment and materials, producing plane geometry drawings, orthographic drawings of components, solid geometry drawings, isometric drawings and assembly drawings.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Use technical drawing tools, equipment and materials | 10 |
|  | Produce plane geometry drawings | 10 |
|  | Produce orthographic drawings of components | 20 |
|  | Produce solid geometry drawings | 10 |
|  | Produce Isometric drawings | 20 |
|  | Produce assembly drawings | 10 |
|  | | 80 |

**Learning Outcomes, Content and Suggested Assessment Methods:**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Use and maintain drawing equipment and materials | * 1. Drawing equipment      1. T square      2. Set square      3. Protractor      4. Engineering drawing set   2. Drawing materials      1. Drawing papers      2. Masking tape      3. Clips      4. Drawing board      5. Clutch pencils   3. Use and maintenance of drawing equipment | * Practical Tests * Written tests |
| 1. Produce plane geometry drawings | * 1. Types of lines in drawings      1. Boarder lines      2. Faint continuous lines      3. Broken lines      4. Chain lines      5. Centre lines      6. Cutting lines   2. Construction of angles      1. Acute angles      2. Right angles      3. Reflex angles      4. Obtuse angles      5. Straight angles   3. Bisection of angles      1. Acute angles      2. Right angles      3. Reflex angles      4. Obtuse angles   4. Measurement of angles      1. Acute angles      2. Right angles      3. Reflex angles      4. Obtuse angles      5. Straight angles   5. Construction of plane geometric forms      1. Triangles      2. Quadrilaterals      3. Polygons      4. Circles and tangents   6. Construction of scales      1. Plane scales      2. Diagonal scale      3. Reducing and enlargement scales | * Practical tests * Written Tests |
| 1. Produce orthographic drawings of components | * 1. Orthographic drawings      1. First angle projection      2. Third angle projection   2. Dimensioning   3. Sectional views   4. Free hand sketches      1. Geometric forms      2. Tools      3. Equipment      4. Mechanical components | * Practical tests * Written Tests |
| 1. Produce solid geometry drawings | * 1. Sketches and drawings of patterns      1. Cylinders      2. Prisms      3. pyramids   2. solids drawings      1. Prisms      2. Cones      3. Cylinders   3. Development and interpenetrations of solids      1. cylinder to cylinder      2. cylinder to prisms      3. prism to prism   4. Different symbols and abbreviations   5. Auxiliary views and true shapes of truncated solids      1. Truncated cylinder      2. Truncated prism      3. Truncated pyramid | * Practical tests * Written Tests |
| 1. Produce isometric drawings | * 1. Isometric sketches and drawings of components   2. Isometric curves and circles   3. Oblique sketches of components | * Practical tests * Written Tests |
| 1. Produce assembly drawings | * 1. Orthographic views of assembly drawings      1. First angle projection      2. Third angle projection   2. Sectional views   3. Parts list | * Practical tests * Written Tests |

**Suggested Methods of Delivery**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Discussions

**Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
|  | Textbooks | Comprehensive texts books on Technical Drawing | 25 pcs | 1:1 |
|  | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:25 |
|  | Working drawings | Working drawings giving a detailed overview of the task at hand |  |  |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:25 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
|  | Drawing Room  /Learning Resource  Area\* | Spacious, equipped with a projector and drawing tables for 25 trainees, approximately 45 sqm (5 m x 9 m) | 1 | 1:25 |
| **C** | **Consumable Materials** |  |  |  |
|  | Drawing papers | A4, A3 and A2 size drawing papers for drafting of sketches and working drawings | 1 ream | 1:25 |
|  | Drawing Pencils | For drawing   * HB * 2H/3H * 2B | Enough |  |
|  | Eraser | Dustless eraser for pencil stains | 30 |  |
|  | Masking Tape | For attaching the drawing paper to the drawing board | Enough |  |
| **D** | **Tools and Equipment** |  |  |  |
|  | Drawing Instruments | The include:   * T-squares * 30-60 degree set squares * 45 degree set square * Protractor * Compass set | 25 sets | 1:1 |
|  | Pencil Sharpener | For creating sharp pencil tips | 25 pcs | 1:1 |
|  | Drawing Tables | For drawing | 25 pcs | 1:1 |
| **E** | **Reference Materials** |  |  |  |
|  | Welding /blueprint /drawing Standards | Reference on industry standards (e.g., BS/ANSI/AWS etc) | 5 pcs | 1:5 |
|  | Multimedia Learning Modules | Videos and tutorials | 25 pcs | 1:1 |

# CORE UNITS OF LEARNING

# VEHICLE FUEL SYSTEM MAINTENANCE

**UNIT CODE: 0716 451 9A**

**UNIT DURATION:** 120Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Maintain Vehicle Fuel System

**Unit Description**

This unit specifies competencies required to maintain vehicle engine. It involves Servicing Vehicle Fuel injection system, Servicing vehicle Intake-Exhaust system, carrying out vehicle engine diagnosis and Performing vehicle fuel system tune up

Fuel system intelligence **Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Service Vehicle Fuel injection system | 30 |
|  | Service vehicle Intake-Exhaust system. | 20 |
|  | Carry out vehicle engine diagnosis | 20 |
|  | Perform vehicle fuel system tune up | 20 |
|  | Fuel system intelligence | 30 |
| TOTAL | | 120 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Service Vehicle Fuel injection system | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures      4. Housekeeping practices      5. Waste disposal   2. Fuel system construction and operation      1. Petrol fuel system      2. Diesel fuel system   3. Petrol injection systems      1. K jetronic      2. KE jetronic      3. D jetronic      4. LE Jetronic      5. L jetronic   4. Layout      1. Throttle body injection system      2. Multipoint injection system      3. Direct petrol injection (GDI)   5. Diesel injection systems      1. Direct injection      2. Indirect injection   6. Fuel system service tools and equipment      1. Uses and maintenance practices   7. Fuel system diagnosis and remedies      1. Short circuit      2. Open circuits      3. Engine control unit malfunction      4. Pressure fluctuations   8. Fuel system inspection      1. Serviceability      2. Leakages      3. Clogging      4. Spray pattern   9. Fuel system components service/replacement      1. Fuel filter      2. Fuel injector      3. Fuel pump      4. Blockage      5. Injector nozzles   10. Fuel system re installation checks       1. Fuel lines       2. Pressure check       3. Injector functionality       4. Leak checks       5. ECU and sensors   11. Fuel system service documentation       1. Customer details and vehicle details       2. Over view of fuel system condition and service report | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Service vehicle intake-Exhaust system | * 1. Functions of intake- exhaust system   2. Exhaust system components      1. catalytic converter      2. Oxygen sensor      3. Muffler / Silencers      4. Manifold      5. Air filter      6. Tail pipe      7. Turbo chargers      8. Super chargers   3. Exhaust system faults   4. Intake-exhaust system tools, equipment and materials   5. Intake exhaust system diagnosis   6. Intake Exhaust service safety measures   7. Intake-Exhaust system parts installation   8. Intake Exhaust system service documentation | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Carry out vehicle Engine diagnosis | * 1. Diagnosis safety measures   2. Diagnosis tools, equipment and materials   3. Engine management system      1. ECU      2. Engine sensors   4. On board diagnostics      1. Diagnostics trouble codes | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Perform vehicle fuel system tune up | * 1. Workplace organisation and safety measures   2. Tune up tools and equipment   3. Engine mapping      1. Speed      2. Load (throttle opening)      3. Ignition timing      4. Air-fuel ratio      5. Engine      6. Ambient temperatures   4. Tune up service documentation | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Fuel system intelligence | * 1. Variable valve timing (VVT)      1. Variable valve timing with intelligence (VVTI)      2. Valve mastic      3. Sky active      4. Turbo stratified injection (TSI)      5. Turbo charged diesel injection (TDI   2. Layout      1. Throttle body injection system      2. Multipoint injection system      3. Direct petrol injection (GDI)   3. Diesel injection systems      1. Direct injection      2. Indirect injection   4. Diesel electronic fuel injection      1. Layout      2. Operation      3. Filling phase      4. Spill phase      5. Injection phase      6. Pressure drop phase      7. Common rail   5. Fuel system diagnosis      1. Short circuit      2. Open circuits      3. Pressure fluctuations   6. Fuel system inspection      1. Serviceability      2. Leakages      3. Clogging      4. Spray pattern   7. Fuel system components service/replacement   8. Fuel system re installation checks   9. Fuel system service documentation | * Practical * Project * Portfolio of evidence * Third party report * Written tests |

**Suggested Methods of Instruction**

* + Demonstrations
  + Practical
  + Projects
  + Group Discussion
  + Direct instructions

The delivery may also be supplimented and enhanced by the following , if the opportunity allows;

* Visiting lecturer/trainer from the motor vehicle service and repair sector
  + Industrial visits

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
| 1 | Textbooks | Comprehensive texts on engine service. | 5 pcs | 1:5 |
| 2 | Charts | Visual aids covering engine and safety protocols | 10 pcs | 1:2.5 |
| 3 | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
| 1 | Lecture/Theory Room | Equipped with projectors and seating for 25 trainees, ~60 sqm | 1 | 1:25 |
| 2 | Workshop | Hands-on training area with workbenches, tools, and safety equipment, ~80 sqm | 1 | 1:25 |
| 3 | Computer Laboratory | Equipped with internet access | 5 | 1:5 |
|  |  |  |  |  |
| **C** | **Consumable Materials** |  |  |  |
|  | First aid kit |  | 5 pieces | 1:5 |
|  | Lubricating oil | For replacing during overhaul | 10 litres | 2:5 |
|  | Petrol fuel | For testing and running engine | 10 litres | 2:5 |
|  | diesel fuel | For testing and running engine | 10 litres | 2:5 |
|  | Paraffin | For cleaning components during overhaul | 10 litres | 2:5 |
|  | Anti rust solution | For cleaning rusted parts | 5 pcs | 1:5 |
|  | Cotton waste | For cleaning components | 1 bag |  |
|  | Valve grinding paste | For grinding valves | 10 pieces | 2:5 |
|  | Oil filter | For replacement during service | 2 |  |
|  | Fuel filter | For replacement during service | 2 |  |
|  | Air filters | For replacement during service | 2 |  |
|  | Coolant | For replacement during service | 10 litres | 2:5 |
|  |  |  |  |  |
|  |  |  |  |  |
| **D** | **Tools and Equipment** |  |  |  |
|  | Diesel vehicle | For servicing engine | 1 | 1:25 |
|  | Petrol vehicle | For servicing engine | 1 | 1:25 |
|  | Petrol engines | For overhauling | 5 | 1:5 |
|  | Diesel engines | For overhauling | 5 | 1:5 |
|  | Complete combination cabinet toolbox | Assorted sets for various applications | 5 cabinets | 1:5 |
|  | Engine stand | For mounting engines | 10 | 2:5 |
|  | Trolley jacks | For lifting engines | 2 | 1:13 |
|  | Valve spring compressors | For removing engine valves | 5 | 1:5 |
|  | Piston ring squeezers | For fitting piston rings | 5 | 1:5 |
|  | Cooling system test kit | For testing cooling system components | 2 | 1:13 |
|  | Petrol engine compression gauge | For testing | 1 | 1:25 |
|  | Diesel engine compression gauge | For testing | 1 | 1:25 |
|  | Cylinder bore gauge | For testing | 2 sets | 1:13 |
|  | Vacuum gauge | For testing engine vacuum | 2 | 1:13 |
|  | Air compressor | For compressed air supply | 1 | 1:25 |
|  | Multimeter | For testing | 5 | 1:25 |
|  | OBD II scanner | For diagnosis | 5 | 1:25 |
|  | Hydraulic press | For pressing | 1 | 1:25 |
|  | Diesel pump Calibration machine | For testing phasing and calibration | 1 | 1:25 |
|  | Injector testing machine | For testing injection pressure | 1 | 1:25 |
|  | Spark plug testing machine | For testing spark plug functionality | 1 | 1:25 |
|  | Work tables with vices |  | 5 | 1:5 |
|  | Dust bin | For dust collecting | 3 | 1:9 |
|  | Waste oil tank | For collecting waste oil | 1 | 1:25 |
| **E** | **PPE (Personal Protective Equipment)** |  |  |  |
| 1 | PPE Sets | Includes gloves, safety boot, and overall/ dust bin | 25 sets | 1:1 |
| 2 | Safety Signs and Barriers | For simulating safety zones and hazards | 10 sets | 1:2.5 |
| 3 | Wheel chokes | For choking wheels while servicing | 8 pieces | 1:3 |
|  |  |  |  |  |
| **F** | **Reference Materials** |  |  |  |
| 1 | Engine manuals | Covering principles and practices in automation | 25 pcs | 1:1 |
| 3 | Technical Handbooks | On vehicle engine service | 25 pcs | 1:1 |
| 4 | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
| 5 | Multimedia Learning Modules | Digital licenses for videos and tutorials | 25 pcs | 1:1 |
| 6 | Practical Assessment Guides | Worksheets for practical assessments | 25 pcs | 1:1 |

# AUTOMOTIVE ELECTRICAL SYSTEMS MAINTENANCE

**UNIT CODE: 0716 551 10A**

**UNIT DURATION: 120** Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency Maintain Automotive Electrical systems

**Unit Description**

This unit specifies competencies required to Service Vehicle ignition system, Service Vehicle Charging system, Service Vehicle Starting system and Service Vehicle lighting system.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Service Vehicle ignition system | 30 |
|  | Service Vehicle Charging system | 30 |
|  | Service Vehicle Starting system | 30 |
|  | Service Vehicle lighting system | 30 |
| TOTAL | | 120 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * 1. Service Vehicle ignition system | * 1. Work area organization and maintenance      1. Setting up the work place      2. Proper storage and labelling of tools equipment and materials      3. Proper house keeping   2. Ignition system service safety measures   3. Tools and equipment   4. Electronic diagnostic equipment;   5. Multi-meters   6. Hydrometer   7. High-rate discharge tester   8. Battery charger   9. Ignition Coil Tester   10. Spark Plug Tester   11. Oscilloscope   12. Ignition system construction and operations  1. Coil ignition 2. Transistor assisted ignition 3. Electronic ignition 4. Capacitor discharge ignition 5. Wasted spark ignition    1. Ignition system diagnosing 6. Vehicle On Board Diagnostics 7. Running test    1. Ignition system components inspection/service/replacement 8. Battery 9. Sparkplugs 10. Distributor 11. Ignition coil 12. Wiring 13. Condenser     1. Ignition system testing 14. Coil output 15. Spark intensity     1. Ignition system service documentation | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| * 1. Service Vehicle Charging system | * 1. Work area organization and maintenance      1. Setting up the work place      2. Proper storage and labelling of tools equipment and materials      3. Proper house keeping   2. Tools and equipment  1. Multi-meter 2. Test lamp 3. Wrenches 4. Screw drivers 5. pliers    1. Charging system diagnosis    2. Vehicle Charging system components construction/operations    3. Vehicle charging system components inspection/service/replacement 6. Battery 7. Ignition Switch 8. Ignition relay 9. Fuse 10. Alternator 11. Rectifier 12. Voltage Regulator     1. Charging system testing 13. Alternator output 14. Battery voltage 15. Electrical shorts 16. continuity     1. charging system service documentation | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| * 1. Service vehicle Starting system | * 1. Work area organization and maintenance  1. Setting up the work place 2. Proper storage and labelling of tools equipment and materials 3. Proper house keeping    1. Tools and equipment 4. Multi-meter 5. Growler machine 6. Test lamps 7. OBD-II scanner 8. Screw drivers    1. Starting system diagnosis    2. Starter motor operation/ construction 9. Inertia starter motor 10. Pre-engaged 11. Types of starter motor e.g.  * Axial starter motor * Co axial motor * Gear reduction-single, double   1. Starting system components inspection/service/replacement  1. Battery 2. Ignition Switch 3. Solenoid switch 4. Starter motor 5. Solenoid switch 6. Electrical Cables etc.    1. Vehicle starting system testing 7. bench testing 8. battery voltage testing 9. solenoid switch testing 10. armature testing 11. field windings testing     1. Vehicle Starting system service documentation | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| * 1. Service vehicle lighting system | * 1. Work area organization and maintenance  1. Setting up the work place 2. Proper storage and labelling of tools equipment and materials 3. Proper house keeping    1. Tools and equipment 4. Beam setter 5. Multi-meter 6. Screw drivers/ testers 7. Wire strippers 8. Side cutters    1. Lighting system diagnosis    2. Lighting system construction/operation/inspection/ circuits    3. Lighting system components inspection/service/replacement 9. Connectors 10. Switches 11. lamps 12. Relays 13. Flasher units 14. fuses 15. bulbs     1. Lighting system testing 16. Continuity 17. Testing the bulbs 18. Switches and controls 19. voltage     1. lighting system service documentation | * Practical * Project * Portfolio of evidence * Third party report * Written tests |

**Suggested Methods of Instruction**

* + Demonstrations
  + Practical
  + Projects
  + Group Discussion
  + Direct instructions

The delivery may also be supplimented and enhanced by the following , if the opportunity allows;

* Visiting lecturer/trainer from the motor vehicle service and repair sector
* Industrial visits

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
| 1 | Textbooks | Comprehensive texts on automotive electrical service. | 5 pcs | 1:5 |
| 2 | Charts | Visual aids covering braking and safety protocols | 10 pcs | 1:2.5 |
| 3 | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
| 1 | Lecture/Theory Room | Equipped with projectors and seating for 25 trainees, ~60 sqm | 1 | 1:25 |
| 2 | Workshop | Hands-on training area with workbenches, tools, and safety equipment, ~80 sqm | 1 | 1:25 |
| 3 | Computer Laboratory | Equipped with internet access | 5 | 1:5 |
| **C** | **Consumable Materials** |  |  |  |
|  | First aid kit |  | 5 pieces | 1:5 |
|  | Battery sulphuric acid | For replacing during service | 10 litres | 2:5 |
|  | Distilled water | For replacing during service | 10 litres | 2:5 |
|  | Insulating tape | For repairing components |  |  |
|  | Soldering wire | For repairing components |  |  |
|  | Paraffin | For cleaning components during services | 10 litres | 2:5 |
|  | Cable ties |  |  |  |
|  | Switches | For replacing during service | 5 pcs | 1:5 |
|  | Cotton waste | For cleaning components | 1 bag |  |
| **D** | **Tools and Equipment** |  |  |  |
|  | Complete vehicle | For servicing electrical components | 1 | 1:25 |
|  | Vehicle starting system model | For demonstrations | 1 | 1:25 |
|  | Vehicle lighting system model | For demonstrations | 1 | 1:25 |
|  | Vehicle charging system model | For demonstrations | 1 | 1:25 |
|  | Vehicle ignition system model | For demonstrations | 1 | 1:25 |
|  | Test lamp/multimeter | For testing | 5 | 1:5 |
|  | Battery charger | For charging battery | 2 | 1:13 |
|  | Spark plug testing machine | For testing spark plug functionality | 2 | 1:13 |
|  | OBD II scanner | For diagnosis | 5 | 1:5 |
|  | Oscilloscope | For diagnosis | 5 | 1:5 |
|  | Complete combination cabinet toolbox | Assorted sets for various applications | 5 cabinets | 1:5 |
|  | Timing light | For diagnosis | 5 | 1:5 |
|  | Trolley jacks | For lifting the vehicle | 2 | 1:13 |
| **E** | **PPE (Personal Protective Equipment)** |  |  |  |
| 1 | PPE Sets | Includes gloves, safety boot, and overall/ dust bin | 25 sets | 1:1 |
| 2 | Safety Signs and Barriers | For simulating safety zones and hazards | 10 sets | 1:2.5 |
| 3 | Wheel chokes | For choking wheels while servicing | 8 pieces | 1:3 |
| **F** | **Reference Materials** |  |  |  |
| 1 | vehicle manuals | Covering principles and practices in vehicle electrical system | 25 pcs | 1:1 |
| 3 | Technical Handbooks | On vehicle fuel service | 25 pcs | 1:1 |
| 4 | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
| 6 | Practical Assessment Guides | Worksheets for practical assessments | 25 pcs | 1:1 |

# MODULE IV

# BASIC UNITS OF LEARNING

# DIGITAL LITERACY

**ISCED UNIT CODE:** **0611 441 11A**

**Relationship with Occupational Standards**

This unit addresses the Unit of Competency: Apply Digital Literacy

**Duration of Unit:** **40 Hours**

**Unit Description**

This unit covers the competencies required to demonstrate digital literacy. It involves operating computer devices, solving tasks using the Office suite, managing data and information, performing online communication and collaboration, applying cybersecurity skills and job entry techniques, and performing jobs online.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Operate Computer Devices | 6 |
|  | Solve Tasks Using Office Suite | 14 |
|  | Manage Data and Information | 6 |
|  | Perform Online Communication and Collaborations | 4 |
|  | Apply Cybersecurity Skills | 4 |
|  | Perform Online Jobs | 4 |
|  | Apply job entry techniques. | 2 |
|  | | 40 |

**Learning Outcomes, Content, and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
| --- | --- | --- |
| * + 1. Operate computer devices | * 1. Meaning and importance of digital literacy   2. Functions and Uses of Computers   3. Classification of computers   4. Components of a computer system   5. Computer Hardware      1. The System Unit E.g. Motherboard, CPU, casing      2. Input Devices e.g. Pointing, keying, scanning, voice/speech recognition, direct data capture devices.      3. Output Devices e.g. hardcopy output and softcopy output      4. Storage Devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, Hard Drives, CDs & DVDs, Memory cards, Flash drives      5. Computer Ports e.g. HDMI, DVI, VGA, USB type C etc.   6. Classification of computer software   7. Operating system functions   8. Procedure for turning/off a computer   9. Mouse use techniques   10. Keyboard Parts and Use Techniques   11. Desktop Customization   12. File and Files Management using an operating system   13. Computer Internet Connection Options       1. Mobile Networks/Data Plans       2. Wireless Hotspots       3. Cabled (Ethernet/Fiber)       4. Dial-Up       5. Satellite   14. Computer external devices management       1. Device connections       2. Device controls (volume controls and display properties) | * Observation * Written assessment * Oral assessment * Practical assessment |
| * + 1. Solve tasks using Office suite | * 1. Meaning and Importance of Word Processing   2. Examples of Word Processors   3. Working with word documents      1. Open and close word processor      2. Create a new document      3. Save a document      4. Switch between open documents   4. Enhancing productivity      1. Set basic options/preferences      2. Help resources      3. Use magnification/zoom tools      4. Display, hide built-in tool bar      5. Using navigation tools   5. Typing Text   6. Document editing (copy, cut, paste commands, spelling and Grammar check)   7. Document formatting      1. Formatting text      2. Formatting paragraph      3. Formatting styles      4. Alignment      5. Creating tables      6. Formatting tables   8. Graphical objects      1. Insert object (picture, drawn object)      2. Select an object      3. Edit an object      4. Format an object   9. Document Print setup      1. Page layout,      2. Margins set up      3. Orientation.   10. Word Document Printing   11. Meaning & Importance of electronic spreadsheets   12. Components of Spreadsheets   13. Application areas of spreadsheets   14. Using spreadsheet application       1. Parts of Excel screen: ribbon, formula bar, active cell, name box, column letter, row number, Quick Access Toolbar.       2. Cell Data Types       3. Block operations       4. Arithmetic operators (formula bar (-, +, \*, /).       5. Cell Referencing   15. Data Manipulation       1. Using Functions (Sum, Average, SumIF, Count, Max, Max, IF, Rank, Product, mode etc)       2. Using Formulae       3. Sorting data       4. Filtering data       5. Visual representation using charts   16. Worksheet printing   17. Electronic Presentations   18. Meaning and Importance of electronic presentations   19. Examples of Presentation Software   20. Using the electronic presentation application       1. Parts of the PowerPoint screen (slide navigation pane, slide pane, notes, the ribbon, quick access toolbar, and scroll bars).       2. Open and close presentations       3. Creating Slides (Insert new slides, duplicate, or reuse slides.)       4. Text Management (insert, delete, copy, cut and paste, drag and drop, format, and use spell check).       5. Use magnification/zoom tools       6. Apply or change a theme.       7. Save a presentation       8. Switch between open presentations   21. Developing a presentation       1. Presentation views       2. Slides       3. Master slide   22. Text       1. Editing text       2. Formatting       3. Tables   23. Charts       1. Using charts       2. Organization charts   24. Graphical objects       1. Insert, manipulate       2. Drawings   25. Prepare outputs       1. Applying slide effects and transitions       2. Check and deliver          1. Spell check a presentation          2. Slide orientation          3. Slide shows, navigation   26. Print presentations (slides and handouts) | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| * + 1. Manage Data and Information | * 1. Meaning of Data and information   2. Importance and Uses of data and information   3. Types of internet services      1. Communication Services      2. Information Retrieval Services      3. File Transfer      4. World Wide Web Services      5. Web Services      6. Automatic Network Address Configuration      7. News Group      8. Ecommerce   4. Types of Internet Access Applications   5. Web browsing concepts      1. Key concepts      2. Security and safety   6. Web browsing      1. Using the web browser      2. Tools and settings      3. Clearing Cache and cookies      4. URIs      5. Bookmarks      6. Web outputs   7. Web based information      1. Search      2. Critical evaluation of information      3. Copyright, data protection   8. Downloads Management   9. Performing Digital Data Backup (Online and Offline)   10. Emerging issues in internet | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| * + 1. Perform online communication and collaboration | * 1. Netiquette principles   2. Communication concepts      1. Online communities      2. Communication tools      3. Email concepts   3. Using email      1. Sending email      2. Receiving email      3. Tools and settings      4. Organizing email   4. Digital content copyright and licenses   5. Online collaboration tools      1. Online Storage (Google Drive)      2. Online productivity applications (Google Docs & Forms)      3. Online meetings (Google Meet/Zoom)      4. Online learning environments      5. Online calendars (Google Calendars)      6. Social networks (Facebook/Twitter - Settings & Privacy)   6. Preparation for online collaboration      1. Common setup features      2. Setup   7. Mobile collaboration      1. Key concepts      2. Using mobile devices      3. Applications      4. Synchronization | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| * + 1. Apply cybersecurity skills | * 1. Data protection and privacy      1. Confidentiality of data/information      2. Integrity of data/information      3. Availability of data/information   2. Internet security threats      1. Malware attacks      2. Social engineering attacks      3. Distributed denial of service (DDoS)      4. Man-in-the-middle attack (MitM)      5. Password attacks      6. IoT Attacks      7. [Phishing Attacks](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#phishing-attacks)      8. [Ransomware](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#ransomware)   3. Computer threats and crimes   4. Cybersecurity control measures      1. Physical Controls      2. Technical/Logical Controls (Passwords, PINs, Biometrics)      3. Operational Controls   5. Laws governing protection of ICT in Kenya      1. The Computer Misuse and Cybercrimes Act No. 5 of 2018      2. The Data Protection Act No. 24 Of 2019 | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| * + 1. Perform Online Jobs | * 1. Introduction to online working   2. Types of online Jobs   3. Online job platforms      1. Remotask      2. Data annotation tech      3. Cloud worker      4. Upwork      5. Oneforma      6. Appen   4. Online account and profile management   5. Identifying online jobs/job bidding   6. Online digital identity   7. Executing online tasks   8. Management of online payment accounts. | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| * + 1. Apply job entry techniques | * 1. Types of job opportunities      1. Self-employment      2. Service provision      3. product development      4. salaried employment         1. Sources of job opportunities   2. Resume/curriculum vitae      1. What is a CV      2. How long should a CV be      3. What to include in a CV      4. Format of CV      5. How to write a good CV      6. Don’ts of writing a CV   3. Job application letter      1. What to include      2. Addressing a cover letter      3. Signing off a cover letter   4. Portfolio of Evidence      1. Academic credentials      2. Letters of commendations      3. Certification of participations      4. Awards and decorations   5. Interview skills      1. Listening skills      2. Grooming      3. Language command      4. Articulation of issues      5. Body language      6. Time management      7. Honesty   6. Generally knowledgeable in current affairs and technical area | * + Observation   + Oral assessment   + Portfolio of evidence   + Third party report * Written assessment |

**Suggested Methods Instruction**

* + Instructor-led facilitation using active learning strategies
  + Demonstration by trainer
  + Practical work by trainees
  + Viewing of related videos
  + Group discussions
  + Project
  + Role play
  + Case study

**Recommended Resources for 30 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
|  | Textbooks | Comprehensive texts books on Digital Literacy | 30 pcs | 1:1 |
|  | Installation Manuals | Detailed guides for equipment and software installation and troubleshooting | 5 pcs | 1:5 |
|  | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:30 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:30 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:30 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:30 |
|  | Templates | Templates for creating various documents e.g. CV, Cover Letter, etc. | 30 | 1:1 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
|  | Lecture/Theory Room  /Learning Resource  Area\* | Spacious, equipped with projectors and Seats for 30 trainees, approximately 45 sqm (5 m x 9 m) | 1 | 1:30 |
|  | Computer Laboratory | Equipped with at least 30 functional computers with internet connectivity and the following software:   * + - Windows/ Linux/ Macintosh Operating System     - Microsoft Office Software     - Google Workspace Account     - Antivirus Software | 30 | 1:1 |
| **C** | **Consumable Materials** |  |  |  |
|  | Printing Papers | A4 and A3 Printing papers suitable for the task | Enough |  |
|  | Whiteboard Marker Pens | Dry-erase markers for trainers use. Assorted colors | Enough |  |
|  | Storage devices | Any of the following storage devices:   * USB Flash Drive * USB Hard Drive * Compact Disks (CDs) * Digital Versatile Disks (DVDs) | Enough |  |

# ENTREPRENEURIAL SKILLS

**ISCED UNIT CODE: 0413 441 12A**

**Relationship with occupational standards**

This unit addresses the unit of competency: Apply Entrepreneurial skills.

**Duration of unit: 40 Hours**

**Unit Description:**

This unit covers the competencies required to demonstrate an understanding of entrepreneurship. It involves demonstrating an understanding of financial literacy, applying entrepreneurial concepts identifying entrepreneurship opportunities, applying business legal aspects, and developing business innovative strategies and business plans.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Apply financial literacy | 6 |
|  | Apply the entrepreneurial concept | 4 |
|  | Identify entrepreneurship opportunities | 6 |
|  | Apply business legal aspects | 6 |
|  | Innovate Business Strategies | 6 |
|  | Develop business plan | 12 |
| TOTAL | | 40 |

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply financial literacy | * 1. Personal finance management   2. Balancing between needs and wants   3. Budget Preparation   4. Saving management   5. Factors to consider when deciding where to save   6. Debt management   7. Factors to consider before taking a loan   8. Investment decisions   9. Types of investments   10. Factors to consider when investing money   11. Insurance services   12. insurance products available in the market   13. Insurable risks | * Observation * Project * Written assessment * Oral assessment * Third party report * Interviews |
| 1. Apply entrepreneurial concept | * 1. Difference between Entrepreneurs and Business persons   2. Types of entrepreneurs   3. Ways of becoming an entrepreneur   4. Characteristics of Entrepreneurs   5. salaried employment and self-employment   6. Requirements for entry into self-employment   7. Roles of an Entrepreneur in an enterprise   8. Contributions of Entrepreneurship | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 1. Identify entrepreneurship opportunities | * 1. Sources of business ideas   2. Factors to consider when evaluating business opportunity   3. Business life cycle | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 1. Apply business legal aspects | * 1. Forms of business ownership   2. Business registration and licensing processing   3. Types of contracts and agreements   4. Employment laws   5. Taxation laws | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 1. Innovate business Strategies | * 1. Creativity in business   2. Innovative business strategies   3. Entrepreneurial Linkages   4. ICT in business growth and development | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 1. Develop Business Plan | * 1. Business description   2. Marketing plan   3. Organizational/Management   4. plan   5. Production/operation plan   6. Financial plan   7. Executive summary   8. Business plan presentation   9. Business idea incubation | * Observation * Written assessment * Project * Oral assessment * Third party report |

**Suggested Methods of Instruction**

* Direct instruction with active learning strategies
* Project (Business plan)
* Case studies
* Field trips
* Group Discussions
* Demonstration
* Question and answer
* Problem solving
* Experiential
* Team training
* Guest speakers

**Recommended Resources for 30 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
|  | Textbooks | Comprehensive texts books on Entrepreneurial Skills | 30 pcs | 1:1 |
|  | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:30 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:30 |
|  | Media Resources | These include but are not limited to:   * Video Clips * Audio Clips * TV Sets * Radio Sets * Newspapers * Business Journals * Case studies |  |  |
|  | Templates | Templates for creating various documents e.g. business plan, invoices etc. | 30 | 1:1 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:30 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
|  | Lecture/Theory Room  /Learning Resource  Area\* | Spacious, equipped with projectors and Seats for 30 trainees, approximately 45 sqm (5 m x 9 m) | 1 | 1:30 |
|  | Computer Laboratory | Equipped with at least 15 functional computers with internet connectivity and the following software:   * + - Windows/ Linux/ Macintosh Operating System     - Microsoft Office Software     - Google Workspace Account     - Antivirus Software | 1 | 1:1 |
| **C** | **Consumable Materials** |  |  |  |
|  | Writing Materials | Writing materials for note taking | Enough |  |
|  | Flashcards | For carrying out various activities by trainees | Enough |  |
|  | Charts | Sufficient for group work activities and displaying | Enough |  |
|  | Whiteboard Marker Pens | Dry-erase markers for trainers use. Assorted colours | Enough |  |

# COMMON UNITS OF LEARNING

# WORKSHOP TECHNOLOGY

**UNIT CODE: 0715 451 13A**

**Relationship with Occupational Standards:**

This unit addresses the unit of competency: Apply workshop technology

**Duration of Unit:** 80 Hours

**Unit description**

This unit describes the competencies required by a technician in order to apply workshop practice in their work. It includes applying workshop safety, material science principles and workshop tools and equipment. It also includes performing material preservation and house keeping

**Summary of Learning Outcome**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Apply workshop safety | 10 |
|  | Apply material science principles | 10 |
|  | Apply workshop tools and equipment | 30 |
|  | Perform material preservation | 20 |
|  | Perform housekeeping | 10 |
|  | | 80 |

**Learning Outcomes, Content and suggested assessment methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply workshop safety | * 1. Workshop safety      1. Definition      2. Types and uses of PPE’s   2. Emergence responses steps      1. Common emergencies         1. Fire         2. Chemical spills         3. Injury response   3. Fire safety      1. Fire extinguishers types and uses      2. Flammable materials identification      3. Fire prevention   4. Safe handling and disposal of chemicals and materials      1. Chemical hazard identification      2. Safe handling procedure      3. Storage and labelling of chemicals      4. Chemical disposal procedures      5. Emergency response for chemical exposure   5. Identifying and marking hazardous zones      1. Common hazardous zones         1. Flammable zones         2. High traffic zones         3. Electrical hazard zones         4. Chemical storage areas   6. Work area organization and maintenance      1. Setting up      2. Proper storage and labelling of tools and equipment   7. Workplace hazards and risks      1. Physical hazards         1. Noises         2. Vibration         3. Heat         4. Sharp object      2. Chemical hazards         1. Fuels         2. Oils         3. Cleaning agents      3. Electric hazards         1. Live wires         2. Batteries         3. Electrical systems   8. Workshop accidents, causes and responses      1. Slip, strips and falls      2. Cuts and abrasion      3. Burns      4. Electrical shocks | * Written tests. * Practical * Project * Portfolio of evidence * Third party report |
| 1. Apply material science principles | * 1. Material science principles      1. Definition      2. Importance of material science in engineering   2. Engineering materials Classification and characteristics      1. Metals      2. Polymers      3. Ceramics   3. Properties of engineering materials      1. Mechanical properties         1. Strength         2. Hardness         3. Toughness         4. Malleability         5. Ductility         6. Rigidity      2. Thermal properties         1. Specific heat         2. Thermal expansion      3. Chemical properties         1. Corrosion resistance      4. Electrical properties         1. Electrical conductivity         2. Insulation properties   4. Material selection for engineering materials      1. Factors to consider   5. Material handling safety      1. Handling metals and alloys      2. Chemical and fuels      3. Safety measures for plastics and composites      4. Electrical safety and conductive materials | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |
| 1. Apply Workshop tools and equipment | * 1. Tools and equipment safety and maintenance practices      1. Inspection      2. Safe handling techniques   2. Technical drawing interpretation      1. Purpose of assembly drawing      2. Bill of quantity      3. Assembly instructions   3. Workshop tools and equipment uses and maintenance      1. Measuring tools         1. Tape measure         2. Callipers         3. Micrometer         4. Protractor         5. Spirit level         6. Dial indicator         7. Torque wrench      2. Marking out tools         1. Scriber         2. Marking gauge         3. Combination square      3. Cutting tools         1. Hacksaw         2. Chisel         3. Files         4. Scissors      4. Fitting tools         1. Wrenches         2. Sockets         3. Pliers         4. Hammers         5. Punch         6. Tap and die      5. Forging tools         1. Anvil         2. Hammers         3. Tongs         4. Swage block      6. Sheet metal tools         1. Shears         2. Tin snips         3. Rivet gun         4. Vise      7. Workshop machine         1. Grinding machine         2. Arc welding machine         3. Gas welding machine         4. Drilling machine | * Written tests * Practical * Project * Portfolio of evidence * Third party report |
| 1. Perform material preservation | * 1. Material preservation      1. Definition of material preservation      2. Importances of material preservation      3. Storage techniques   2. Common preservation methods      1. Protective coatings      2. Chemical treatments      3. Physical barriers      4. Controlled storage conditions      5. Proper handling techniques      6. Cleaning and maintenance   3. Material preservation procedure      1. Work requirements assessment      2. Selection of appropriate preservation method | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |
| 1. Perform housekeeping | * 1. Housekeeping      1. Definition      2. Importances of housekeeping   2. Housekeeping activities and their importances      1. Tool and equipment organization      2. Work area cleanliness      3. Safe handling and disposal of hazardous materials      4. Inspection and maintenance of equipment      5. Personal protective equipment management      6. Air and ventilation maintenance      7. Incident prevention and reporting   3. Housekeeping tools and equipment      1. Uses and maintenance         1. Brooms and brushes         2. Dustpans and squeegees         3. Vacuum cleaners         4. Mops and mop buckets         5. Waste bins and recycling containers   4. Housekeeping materials      1. Cleaning cloths and rags      2. Cleaning agents and solvents      3. Lubricants      4. Gloves and PPE’s      5. Disposable bags and liners   5. Workshop waste sorting and disposal      1. Types of waste         1. General waste         2. Hazardous waste         3. Recyclable waste         4. Organic waste         5. e-waste      2. Waste sorting procedure         1. Designated bins for different types of waste         2. Sorting by material         3. Pre-sorting hazardous waste      3. Hazardous waste disposal         1. Chemical waste         2. Used oil and solvents         3. Paints and finishes | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |

**Suggested Delivery Methods**

* Demonstration
* Discussions
* Practical
* Industrials visits
* Simulation

**List of Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |
|  | Textbooks | Comprehensive textbooks on workshop technology | 25 | 1:1 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:25 |
|  | Computer | Functional desktop computer with online instructional content | 1 | 1:25 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:25 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** |
|  | Lecture/Theory Room | Spacious room with seats for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Standard workshop with bench/fitting area and welding booths approximately 80 sqm | 1 | 1:25 |
| **C** | **Materials and Supplies** |
|  | Dust coat/ overall | Shields skin and regular clothes from sparks | 25 | 1: |
|  | Gloves | Shields hands from sharp edges, heat, and chemical exposure | 25 | 1:1 |
|  | Safety boots | Protects feet from heavy objects, sharp materials, and impact. | 25 | 1:1 |
|  | Welding helmets | Protecting the eyes while providing a clear view of the weld. | 25 | 1:1 |
|  | Ear muffs/ ear plugs | Shields against prolonged exposure to high noise levels from machinery | 25 | 1:1 |
|  | Safety goggles | Protects eyes from flying metal particles, sparks, and dust | 25 | 1:1 |
|  | Raw materials | Steel and aluminum  Plates   * 4mm thickness. * 6 mm thickness.   Pipes   * 4 mm thickness * 6 mm thickness | enough |  |
|  | Arc welding electrodes | Electrodes used in Arc welding | 20 packets |  |
|  | First Aid kit | Fully equipped First Aid kit for use in case of accidents | 1 | 1:25 |
|  | Brooms and cleaning stuff | Hand brooms and mops for cleaning | 10 | 2:5 |
|  | Cotton waste | Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment | Enough |  |
|  | Cleaning detergents | General degreasers | 10 liters |  |
| Floor detergents | 10 liters |
| Hand detergents | 10 liters |
| **D** | **Tools and Equipment** |
| **Measuring tools** | | | | |
|  | Steel rules | Calibrated steel rules for linear measurements | 20 | 4:5 |
|  | Vernier calipers | Calibrated vernier calipers for linear measurements | 20 | 4:5 |
|  | Tri squares | Properly aligned steel Tri-square for checking perpendicular edges | 5 | 1:5 |
|  | Vernier height gauge and surface plates | Calibrated vernier height gauges and surface plates for measurement of heights | 5 | 1:5 |
|  | Measuring tapes | Calibrated measuring tapes for linear measurements | 20 | 4:5 |
|  | Angle gauges | Calibrated steel rules for linear measurements | 5 | 1:5 |
| **Marking out tools** | | | | |
|  | Scribers | steel pencil scribers for marking out lines on metal surfaces | 20 | 4:5 |
|  | Dot punches | Steel dot punches for marking out centres | 20 | 4:5 |
|  | Calipers | Quality steel calipers for marking out arcs on metal surfaces | 5 | 1:5 |
| **Cutting Tools** | | | | |
|  | Assorted hand files | Flat and round hand files for material preparation and finishing | 20 | 4:5 |
|  | Hacksaws | Hack saws with functional frames and blades for cutting metal plates and pipes | 20 | 4:5 |
|  | Tinsnips |  | 10 | 2:5 |
|  | Angle grinders | Portable angle grinders with cutting and grinding disks for cutting and grinding metal plates and pipes | 5 | 1:5 |
| **Work holding tools** | | | | |
|  | Work benches | Stable work benches for carrying out bench work | 5 | 1:5 |
|  | Collet | Hold the tungsten electrode in place | 5 | 1:5 |
|  | Bench vices | Functional bench vices/clamps for holding work pieces during bench work | 20 | 4:5 |
|  | Tongs | Functional pairs of tongs for holding hot pieces of metal during welding | 10 | 2:5 |
| **Finishing tools** | | | | |
|  | Wire brushes | To clean metal surfaces | 20 | 4:5 |
|  | File cards | Cleaning tool used to maintain files | 5 | 1:5 |
| **E** | **Machines and Equipment** |
|  | Arc welding machine | For welding operations | 5 | 1:5 |
|  | Gas welding machine | For welding operations | 5 | 1:5 |
|  | Firefighting equipment | for ensuring safety in workshops where fire hazards are present, such as sparks | 3 |  |
|  | Welding gun | Feeds the filler wire into the weld pool | 5 | 1:5 |
|  | Drilling machine | For drilling operations | 5 | 1:5 |
| **F** | **Reference Materials** |
| 1 | Working drawings |  |  |  |
| 2 | Operation sheets/ templates |  |  |  |
| 3 | Welding Procedure Specifications (WPS) |  | 25 pcs | 1:1 |
| 4 | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
| 6 | Practical Assessment Guides | Worksheets for practical assessments | 25 pcs | 1:1 |

# MECHANICAL SCIENCE

**UNIT CODE: 0715 441 14A**

**Relationship with Occupational Standards**: Apply Mechanical Science

**Duration of Unit**: **80Hours**

**Unit Description**

This unit describes the competences required in order to apply mechanical science. It includes resolving forces, determining effects of loads in mechanical systems, analysing properties of materials, determining the nature of friction in mechanical systems and solving problems related to motion.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Resolve forces | 10 |
|  | Determine effects of loads in mechanical systems. | 20 |
|  | Analyze properties of materials. | 10 |
|  | Determine the nature of friction in mechanical systems | 20 |
|  | Solve problems related to motion. | 20 |
| TOTAL | | 80 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Resolve forces | * 1. Definition of force   2. Types of force systems      1. Colinear      2. Coplanar      3. Concurrent   3. Theorems of forces      1. Triangle      2. Parallelogram      3. Polygon   4. Resolution of forces      1. Analysis      2. Graphical Method | * Written Tests * Portfolio of Evidence |
| 1. Determine effects of loads in mechanical systems. | * 1. Types of Forces      1. Friction      2. Centrifugal      3. Centripetal      4. Gravitational      5. Inertia   2. Moments      1. Definition      2. Calculations of moment of force about an axis   3. Principles of Moments      1. Clockwise and anticlockwise moments   4. Application of Moments of Forces in Engineering      1. Simply supported beams having point loads   5. Determination of moment couples      1. Simply supported beams with couples | * Written Tests * Portfolio of Evidence |
| 1. Analyze properties of materials | * 1. Mechanical Properties of Materials:      1. Strength (Compressive, Shear. And Tensile)      2. Brittleness      3. Hardness      4. Malleability      5. Plasticity      6. Elasticity      7. Toughness   2. Mechanical Materials Properties Tests      1. Tensile Test      2. Hardness Test   3. Direct Stresses      1. Define Stress      2. Types of Stress:         1. Tensile stress         2. Compressive stress      3. Calculate Stress   4. Selection of Materials      1. Factors to Consider in Materials Selection | * Written Tests * Portfolio of Evidence |
| 1. Determine the nature of friction in mechanical systems | * 1. Friction      1. Definition      2. Advantages and disadvantages of friction   2. Laws of Friction:      1. Laws of static friction      2. Laws of dynamic friction   3. Effects of Friction   4. Applications of Friction      1. Lubrication      2. Tyre Traction      3. Braking Systems      4. Bearing and Bushings      5. Grinding of Tools      6. Transmission Systems | * Written Tests * Portfolio of Evidence |
| 1. Solve problems related to motion. | * 1. Definition of terms      1. Distance      2. Displacement      3. Time      4. Speed      5. Velocity      6. Acceleration   2. Laws of Motion      1. Newton’s First Law of Motion      2. Newton’s Second Law of Motion      3. Newton’s Third Law of Motion   3. Calculating Parameters of Motion      1. Equations of linear and angular motion      2. Calculations         1. Displacement         2. Speed         3. Velocity         4. Acceleration   4. Linear and Angular Motion      1. Converting         1. Angular to Linear Motion         2. Linear to angular motion   5. Motion Graphs      1. Displacement/Time Graphs      2. Velocity/Time Graphs | * Written Tests * Portfolio of Evidence |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by the trainer
* Online video clips
* Power point presentation

**Recommended Resources for 30 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** | | | |
|  | Textbooks | Comprehensive textbooks on Engineering science | 30 | 1:1 |
|  | Graph books | For graphical representation of solutions | 30 | 1:1 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:30 |
|  | Computer | Functional desktop computer with online instructional content | 1 | 1:30 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:30 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:30 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Spacious room with seats for 25 trainees, approximately 60 sqm | 1 | 1:30 |
| **C** | **Materials and Supplies** | | | |
|  | First Aid kit | Fully equipped First Aid kit for use in case of accidents | 1 | 1:30 |
| **D** | **Tools and Equipment** | | | |
|  | Scientific Calculator | For Calculations | 30 | 1:1 |
| **E** | **Reference Materials** | | | |
|  | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:30 |
|  | Standard Mathematical Tables | For reference on formulae, identities, laws and principles | 30 | 1:1 |

# **ELECTRICAL AND ELECTRONICS PRINCIPLES**

**UNIT CODE:** **0713 441 15A**

**Relationship with Occupational Standards**

This unit addresses the unit of competency: Apply Electrical and electronics principles.

**Unit Duration:** 80 Hours

**Unit Description**

This unit describes the competences required in order to apply electrical and electronics principles. It involves applying basic concepts of electrical quantities, cells and batteries, magnetism and electromagnetism, basic electrical machines and electronics principles.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Apply basic concepts of electrical quantities | 10 |
|  | Apply DC and AC circuits | 10 |
|  | Apply the concept of cells and batteries | 10 |
|  | Apply magnetism and electromagnetism | 10 |
|  | Apply basic electrical machines | 20 |
|  | Apply electronics components | 20 |
| TOTAL | | 80 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Use the concept of basic Electrical quantities | * 1. Basic SI Units      1. Overview of SI Units         1. Power (Watts, W)         2. Current (Amperes, A)         3. Resistance (Ohms, Ω)         4. Voltage (Volts, V)   2. Conductors and Insulators      1. Identification and Characteristics         1. Metals vs. non-metals         2. Applications in electrical circuits   3. Electrical Quantities      1. Charge, Force, Work, and Power      2. Definitions and units      3. Calculations involving Electrical quantities   4. Ohm’s Law      1. Understanding Ohm's Law      2. Practical applications and calculations   5. Basic Electrical and Electronic Measurements      1. Measurement Techniques      2. Use of Multimeters, oscilloscopes, and ammeters      3. Measurement accuracy and calibration | * Portfolio of evidence * Practical test * Third party report * Written tests * Project work |
| 1. Apply DC and AC circuits | * 1. Introduction to Electrical Circuits      1. Introduction to electricity:      2. Voltage, current, and power.      3. Overview of DC and AC circuits.      4. Basic circuit elements: Resistors, capacitors, and inductors.   2. DC Circuit Analysis      1. Series and parallel circuits.      2. Voltage and current division principles.      3. Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL).      4. Analysis of complex circuits using KVL and KCL.      5. Hands-on lab: Building and testing DC circuits.   3. AC circuits analysis      1. Introduction to AC: Sinusoidal waveforms, frequency, and period.      2. RMS values, peak values, and average values.      3. AC voltage and current sources.      4. Phasor representation of AC quantities.      5. Impedance and admittance.      6. Series and parallel AC circuits.      7. Resonance in RLC circuits.      8. Practical analysis of AC circuits using phasors.      9. Power in AC Circuits         1. Power factor and power factor correction.         2. Real, reactive, and apparent power.         3. AC power calculations for single-phase and three-phase circuits.         4. Energy consumption and efficiency.         5. Applications of AC power in household and industrial settings.   4. Practical Activity:      1. Connection in series and Parallel Simulation | * Oral questioning * Portfolio of evidence * Practical test * Third party report * Written tests * Project work |
| 1. Apply the concept of cells and batteries | * 1. Introduction to Cells and Batteries   2. Overview of energy storage and electrochemical cells.   3. Basic concepts: Voltage, current, capacity, and energy density.   4. Internal resistance of cells and electromotive force, e.m.f.   5. Electrochemical principles: Redox reactions and electrode potentials.   6. Components of a cell: Anode, cathode, electrolyte, and separator.   7. Types of cells: Primary vs. secondary cells (non-rechargeable vs. rechargeable).   8. Primary Cells (Non-Rechargeable)      1. Zinc-Carbon Cells: Construction, chemistry, and applications.      2. Alkaline Cells: Advantages over zinc-carbon, usage, and performance characteristics.      3. Comparison of common primary cells (e.g., lithium primary cells).      4. Performance limitations and efficiency of primary cells.      5. Environmental impact and disposal considerations for non-rechargeable batteries.      6. Hands-on lab: Testing the performance of different primary cells.   9. Secondary Cells (Rechargeable)      1. Lead-Acid Batteries: Chemistry, construction, and applications (e.g., automotive).      2. Nickel-Cadmium (NiCd) and Nickel-Metal Hydride (NiMH): Differences, pros, and cons.      3. Charging and discharging cycles of rechargeable cells.      4. Lithium-Ion Batteries: Working principles, construction, and applications.      5. Advantages of lithium-ion technology over older battery types.      6. Safety considerations: Overcharging, thermal runaway, and battery management systems.      7. Emerging Technologies: Solid-state batteries, lithium-sulphur, and other advancements.      8. Energy density and power density considerations in modern applications.      9. Batteries maintenance      10. Hands-on lab: Disassembling and examining a rechargeable battery.   10. Battery Performance and Characteristics       1. Battery capacity: Ampere-hour (Ah) ratings and energy content.       2. Factors affecting battery life: Temperature, charge/discharge rates, and cycling.       3. Internal resistance and its effect on performance.       4. Battery efficiency and energy losses.       5. State of charge (SOC) and depth of discharge (DOD).       6. Battery degradation and aging mechanisms.       7. Measuring battery parameters (voltage, current, capacity).       8. Testing techniques for battery health and performance.       9. Hands-on lab: Performance testing of different battery types.   11. Applications of Batteries       1. Batteries in consumer electronics (e.g., smartphones, laptops).       2. Automotive applications: Starting, lighting, and ignition (SLI) batteries.       3. Electric vehicles (EVs) and hybrid electric vehicles (HEVs): Battery requirements and challenges.       4. Industrial and grid storage applications.       5. Renewable energy integration: Solar and wind energy storage solutions.       6. Specialized applications: Medical devices, aerospace, and military.       7. Case studies on battery failure and safety incidents.       8. Discussion on regulations and standards for battery use.   12. Environmental Impact and Recycling       1. Environmental impact of battery production and disposal.       2. Strategies for reducing the ecological footprint of battery technologies.       3. Recycling processes for different types of batteries.       4. Government policies and regulations regarding battery disposal.       5. Advances in battery recycling technologies.   13. Hands-on lab: Exploring the recycling process and evaluating eco-friendly battery alternatives. | * Portfolio of evidence * Practical test * Third party report * Written tests * Project work |
| 1. Apply magnetism and electromagnetism | * 1. Magnetic Circuits and Devices      1. Introduction to magnetic circuits.      2. Magnetic flux, magnetic field density, magnetic field strength, Reluctance, magnetomotive force (MMF), and magnetic flux.      3. Calculations involving magnetic circuits      4. Analogies between electric and magnetic circuits.      5. Magnetic materials in electrical devices (soft and hard magnetic materials).   2. Electromagnetic Induction      1. Faraday’s Law of electromagnetic induction.      2. Lenz's Law: Direction of induced EMF.      3. Practical applications: Electric generators and transformers.      4. Induced EMF in different configurations (moving conductors, changing magnetic fields).      5. Self-induction and mutual induction.      6. Transformers: Working principles, construction, and applications.      7. Step up and step-down transformers      8. Power losses in transformers.      9. Calculations involving transformers      10. Energy stored in magnetic fields. | * Oral questioning * Portfolio of evidence * Practical test * Third party report * Written tests * Project work |
| 1. Apply basic electrical machines | * 1. DC Machines      1. DC machine construction and types (motors and generators).      2. Working principle of DC generators and back EMF.      3. Types of DC generators: Series, shunt, and compound.      4. Working principle of DC motors.      5. Types of DC motors: Series, shunt, and compound.      6. Speed-torque characteristics of DC motors.      7. Performance analysis and efficiency of DC machines.      8. Starting methods for DC motors.      9. Hands-on lab: Testing and operating a DC motor/generator.   2. Induction Motors (AC Machines)      1. Introduction to induction motors: Construction and working principles.      2. Types of induction motors: Squirrel cage and wound rotor.      3. Rotating magnetic fields and slip in induction motors.      4. Equivalent circuit model of an induction motor.      5. Torque-speed characteristics.      6. Methods of starting and speed control.      7. Performance analysis of induction motors.      8. Losses and efficiency considerations.   3. Hands-on lab: Testing and operating an induction motor. | * Portfolio of evidence * Practical test * Third party report * Written tests * Project work |
| 1. Apply electronics components | * 1. Introduction to Electronic Components      1. Overview of electronics: What are electronic components?      2. Classification of components: Passive, active, and electromechanical.      3. Introduction to circuit symbols and schematic diagrams.      4. Basic electrical quantities and units (voltage, current, resistance).      5. Understanding datasheets and component specifications.      6. Overview of testing and measurement tools (multimeters, oscilloscopes).   2. Passive Components      1. Resistors: Types, color codes, power ratings, and applications.      2. Capacitors: Types (ceramic, electrolytic, film), capacitance value, and working voltage.      3. Charging and discharging of capacitors in DC circuits.      4. Applications of capacitors in filtering, timing, and energy storage.      5. Inductors: Types, inductance value, and applications.      6. Inductor behavior in DC and AC circuits.      7. Introduction to filters: RC, RL, and RLC circuits.   3. Semiconductor Devices      1. Diodes: Introduction to PN junctions, characteristics, and types (LEDs, Zener diodes, Schottky diodes).      2. Applications of diodes in rectification, voltage regulation, and signal clipping.      3. Transistors: Types (BJT and MOSFET), characteristics, and configurations.      4. Basic transistor circuits: Switches and amplifiers.      5. Hands-on lab: Building and testing simple diode and transistor circuits.      6. Special semiconductor devices: Thyristors, TRIACs, and optoelectronic devices.      7. Characteristics and applications in switching and control.   4. Integrated Circuits (ICs)      1. Overview of integrated circuits: Analog vs. digital ICs.      2. Operational amplifiers (Op-Amps): Characteristics and basic configurations.      3. Applications of Op-Amps in signal processing.      4. Timers and oscillators: 555 timer IC and its applications.      5. Voltage regulators: Linear and switching regulators.      6. Introduction to data converters (ADC and DAC).      7. Digital ICs: Logic gates and flip-flops.      8. Applications of digital ICs in basic logic circuits.      9. Hands-on lab: Building circuits using Op-Amps, timers, and logic gates.   5. Electromechanical and Specialized Components      1. Relays: Types, operation, and applications in switching.      2. Switches and connectors: Types and usage in electronic circuits.      3. Transformers: Basic operation, step-up/step-down functions, and isolation.      4. Displays: LED, LCD, and seven-segment displays.      5. Circuit Design and Practical Applications      6. Basic circuit design principles: Bread boarding, PCB layout, and soldering.      7. Introduction to circuit simulation tools (e.g., Multisim, LTSpice).      8. Testing and troubleshooting techniques.      9. Real-world applications of electronic components.      10. Building practical projects: Power supplies, audio amplifiers, and sensor-based circuits.      11. Hands-on lab: Final project assembly and testing. | * Portfolio of evidence * Practical test * Third party report * Written tests * Project work |

**Suggested Methods of Instruction**

* Demonstration by trainer
* Practice by the trainee
* Field trips
* Discussions

**Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
| 1 | Textbooks | Comprehensive texts on electrical and control principle. | 5 pcs | 1:5 |
| 2 | Charts | Visual aids covering electrical theories and safety protocols | 10 pcs | 1:2.5 |
| 3 | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
| 1 | Lecture/Theory Room | Equipped with projectors and seating for 25 trainees, ~60 sqm | 1 | 1:25 |
| 2 | Workshop | Hands-on training area with workbenches, tools, and safety equipment, ~80 sqm | 1 | 1:25 |
| 3 | Computer Laboratory | Equipped with testing setups for electrical experiments, ~50 sqm.  Equipped with computers installed with Circuit simulation software. | 25 | 1:1 |
|  |  |  |  |  |
| **C** | **Consumable Materials** |  |  |  |
| 1 | Electrical Wires | Assorted sizes and color-coded (e.g., 1.5mm², 2.5mm², 4mm²) | 5 rolls | 1:5 |
| 2 | Insulation Tapes | For securing connections and insulation, assorted colors | 25 pcs | 1:1 |
| 3 | Breadboard | For prototyping and testing circuits | 5 pcs | 1:5 |
| 4 | Sensors | Assorted types (temperature, pressure, proximity) | 10 pcs | 1:2.5 |
| 5 | Signal generators | For generating AC signals | 5pcs | 1:5 |
| 6 | Transducers | Assorted | 10 pcs | 1:3 |
| 7 | Electronic components | Resistors, transistors, capacitors, relays, transformers. Integrated IC, OPAM. | 100pcs | 4:25 |
|  |  |  |  |  |
| **D** | **Tools and Equipment** |  |  |  |
| 1 | Screwdrivers | Assorted sets for various applications | 2 sets | 1:12.5 |
| 2 | Side Cutters | For cutting wires and cables | 4 pcs | 1:6.25 |
| 3 | Pliers | For gripping and bending wires | 3 pcs | 1:8.33 |
| 4 | Stripping Knives | For stripping insulation from wires | 4 pcs | 1:6.25 |
| 5 | Computers | Equipped with electrical and electronics simulation software | 5 pcs | 1:5 |
| 6 | Multimeters | For measuring voltage, current, and resistance | 5 pcs | 1:5 |
| 7 | Clamp Meters | For measuring current flow in circuits | 5 pcs | 1:5 |
| 8 | Oscilloscope | For observing waveforms and signals | 1 | 1:25 |
| 9 | Voltmeter | For measuring voltage | 1 | 1:25 |
| 10 | Ammeter | For measuring current | 1 | 1:25 |
| 11 | Signal Generator | For generating electrical signals for testing | 1 | 1:25 |
| 12 | Soldering gun | For soldering | 10 | 1:3 |
| 13 | Soldering wire | For making joints in electrical circuits | 10 | 1:3 |
| 14 | PLC | For program practice | 5 | 1:5 |
| 15 | Cells and batteries | For learning | 5 | 1:5 |
|  |  |  |  |  |
| **E** | **PPE (Personal Protective Equipment)** |  |  |  |
| 1 | PPE Sets | Includes helmets, gloves, safety goggles, shoes, and harnesses | 25 sets | 1:1 |
| 2 | Safety Signs and Barriers | For simulating safety zones and hazards | 10 sets | 1:2.5 |
| 3 | Earthing Test Kits | For ground testing and demonstrating earthing procedures | 5 pcs | 1:5 |
| 4 | Electrical Test Benches | For hands-on testing of functionality and circuit design | 5 pcs | 1:5 |
|  |  |  |  |  |
| **F** | **Reference Materials** |  |  |  |
| 1 | Industrial Automation Manuals | Covering principles and practices in automation | 25 pcs | 1:1 |
| 2 | Electrical Standards | Reference on industry standards (e.g., IEEE Guidelines) | 5 pcs | 1:5 |
| 3 | Technical Handbooks | On motors, drives, and wiring systems | 25 pcs | 1:1 |
| 4 | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
| 5 | Multimedia Learning Modules | Digital licenses for videos and tutorials | 25 pcs | 1:1 |
| 6 | Practical Assessment Guides | Worksheets for practical assessments | 25 pcs | 1:1 |

## 

# CORE UNITS OF LEARNING

# VEHICLE TRANSMISSION SYSTEM MAINTENANCE

**UNIT CODE: 0716 451 16A**

**UNIT DURATION:** 150Hours

This unit addresses the Unit of Competency: Maintain Vehicle Transmission System

**Unit Description**

This unit specifies competencies required to maintain vehicle transmission system. It involves Diagnosing vehicle transmission system, overhauling vehicle clutch assembly, overhauling vehicle gearbox unit, servicing vehicle drive shaft, overhauling vehicle transfer case and overhauling vehicle final drive

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Diagnose manual transmission system | 20 |
|  | Overhauling Vehicle clutch assembly | 20 |
|  | Overhauling manual gear box unit | 30 |
|  | Service Vehicle drive shaft | 20 |
|  | Overhaul Vehicle Transfer case | 30 |
|  | Overhaul vehicle final drive | 30 |
| TOTAL | | 150 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Diagnose vehicle transmission system | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures      4. Housekeeping practices      5. Waste disposal   2. Transmission systems constructions and operations      1. Definition of transmission system      2. Functions of transmission      3. Components and their functions         1. Clutches         2. Gearboxes         3. Propeller shafts         4. Final drive         5. Drive shafts and hubs      4. Principle of operation of transmission components   3. Overview of different transmission layouts      1. Front drive      2. Rear wheel      3. Four-wheel drive         1. Part time         2. Full time/all wheel drive   4. Diagnosis Tools, equipment and materials      1. Diagnostic equipment      2. Safety equipment and precautions   5. Transmission system assessment and checks      1. Fluid leaks      2. External damage      3. Cable and linkage condition      4. Fluid level check      5. Performance assessment   6. Diagnosis documentation      1. Customer details and vehicle details      2. Over view of transmission system condition and service report | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Overhauling Vehicle clutch assembly | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures      4. Housekeeping practices      5. Waste disposal   2. Clutch assembly construction and operation      1. Components      2. Clutch operation and engagement principles   3. Types of clutches      1. Friction clutch      2. Wet clutch      3. Torque convertors   4. Clutch inspection and diagnosis      1. Visual and functional inspection      2. Clutch pedal feel      3. Hydraulic system   5. Clutch assembly dismantling      1. Safety protocols      2. Clutch removal   6. Clutch components inspection for wear and damage      1. Clutch disc wear and tear      2. Flywheel inspection      3. Pressure plate      4. Release bearing and fork   7. Clutch assembly parts service/replacement and fitting      1. Alignment      2. Adjusting clutch linkage and pedal      3. Bleeding hydraulic clutch system      4. Pedal travel      5. Clutch functional testing   8. Clutch system service documentation      1. Over view of clutch condition and service | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Overhauling gear box unit | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures      4. Housekeeping practices      5. Waste disposal   2. Principles of transmission and gear system      1. Power flow in transmission system      2. Gear ratios   3. Types of gears      1. Spur gear      2. Helical gear      3. Double helical   4. Gear box construction and operation      1. Manual gear boxes      2. Automatic gear boxes   5. Gearbox diagnosis and checks      1. Slipping      2. Grinding      3. Hard shifting      4. Noise      5. Fluid leaks   6. Tools, equipment and materials      1. Uses and maintenance   7. Gearbox dismantling procedure      1. Manual gear box      2. Automatic gearbox   8. Gearbox components service/replacement      1. Input and output shaft      2. Gears      3. Synchronizers      4. Bearings      5. Seals and gaskets      6. Shift forks and selector mechanism      7. Bushing and sleeves   9. Gearbox assembly      1. Alignment and positioning of components      2. Setting gear clearance and end play      3. Fluid refill and leaks tests      4. Adjustment and tests for smooth shifting   10. Gearbox mounting       1. Mounting points and alignment       2. Types of mounts and their functions       3. Mounting procedure       4. Testing and checks   11. Gearbox system service documentation       1. Over view of gearbox condition and service | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Service Vehicle drive shaft | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures      4. Housekeeping practices   2. Construction and operation      1. Components and their uses      2. Propeller shaft      3. Universal joint      4. Half shafts      5. Principle of operation   3. Types of drive lines      1. Front drive      2. Rear drive      3. Four-wheel drive   4. Types of propeller shaft joints      1. Cross      2. Lay rub      3. Tripoid      4. Sliding joint      5. Universal joints   5. Drive shaft common faults and remedies      1. Excessive vibration      2. Clunking or clicking noises      3. Shifting or engaging gears difficulties      4. fluid leaks      5. Drive shaft or bearing failure   6. Tools and equipment      1. Uses and maintenance   7. Dismantling and servicing of components      1. Universal joint replacement      2. Constant Velocity joint      3. Balancing and realignment   8. Drive shaft reinstallation and final checks      1. Alignment checks      2. Torque specification      3. Performance check   9. Drive shaft service documentation      1. Overview of drive shaft condition and service | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Overhaul Vehicle Transfer case | * 1. Transfer case overhaul safety measures   2. Construction and operation   3. Transfer case inspection   4. Transfer case dismantling procedure   5. Transfer case components service/replacement   6. Transfer case assembly procedure   7. After service/installation checks   8. Transfer case service documentation | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Overhaul vehicle final drive | * 1. Work area organization and safety measures      1. Importance of a well-organized work area      2. Safety measures      3. Emergency procedures      4. Housekeeping practices   2. Final drive construction and operation      1. Components and their function         1. Crown wheel/ring gear         2. Pinion gear         3. Differential unit      2. Principle of operation   3. Types of vehicle final drive      1. Single speed final drive/convectional      2. Double reduction final drive         1. Two speed final drive      3. Worm and wheel final drive      4. Differential unit-differential lock, limited slip differential unit   4. Vehicle Final drive inspection      1. Visual inspection      2. Gear and bearing wear      3. Fluid inspection   5. Final drive common faults and remedies      1. Noise and vibration      2. Leaks and fluid issues      3. Traction and differential malfunction      4. Backlash   6. Tools and equipment selection      1. Uses and maintenance practices   7. Final drive components dismantling and servicing      1. Setting gear backlash and alignment      2. Bearing replacement      3. Seals and gasket replacement   8. Final drive components reassembly and final testing      1. Reassembly procedure      2. Performance test      3. Fluid level check   9. Final drive service documentation      1. Overview of final drive condition and service | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |

**Suggested Methods of Instruction**

* + Demonstrations
  + Practical
  + Projects
  + Group Discussion
  + Direct instructions

The delivery may also be supplemented and enhanced by the following , if the opportunity allows;

* Visiting lecturer/trainer from the motor vehicle service and repair sector
* Industrial visits

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
| 1 | Textbooks | Comprehensive texts on transmission service. | 5 pcs | 1:5 |
| 2 | Charts | Visual aids covering transmission and safety protocols | 10 pcs | 1:2.5 |
| 3 | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
| 1 | Lecture/Theory Room | Equipped with projectors and seating for 25 trainees, ~60 sqm | 1 | 1:25 |
| 2 | Workshop | Hands-on training area with workbenches, tools, and safety equipment, ~80 sqm | 1 | 1:25 |
| 3 | Computer Laboratory | Equipped with internet access | 5 | 1:5 |
|  |  |  |  |  |
| **C** | **Consumable Materials** |  |  |  |
|  | First aid kit |  | 5 pieces | 1:5 |
|  | Lubricating oil | For replacing during overhaul | 10 litres | 2:5 |
|  | Paraffin | For cleaning components during overhaul | 10 litres | 2:5 |
|  | Anti rust solution | For cleaning rusted parts | 5 pcs | 1:5 |
|  | Cotton waste | For cleaning components | 1 bag |  |
|  | Transmission fluid | For lubrication | 10 litres | 2:5 |
|  | Engineers blue | For marking | 25 pieces | 1:1 |
|  |  |  |  |  |
| **D** | **Tools and Equipment** |  |  |  |
|  | Manual vehicle | For servicing transmission system | 1 | 1:25 |
|  | Automatic vehicle | For servicing transmission system | 1 | 1:25 |
|  | Manual Clutch assembly | For servicing | 5 | 1:25 |
|  | Torque convertor | For servicing | 5 | 1:25 |
|  | Manual gearbox | For overhauling | 5 | 1:5 |
|  | Automatic gearbox | For overhauling | 5 | 1:5 |
|  | Drive shaft | For servicing | 5 | 1:5 |
|  | Final drive unit | For overhauling | 10 | 2:5 |
|  | Automatic transmission system models | For demonstrations | 1 | 1:25 |
|  | Manual transmission system models | For demonstrations | 1 | 1:25 |
|  | Complete combination cabinet toolbox | Assorted sets for various applications | 5 cabinets | 1:5 |
|  | Transmission Jack | For mounting engines | 10 | 2:5 |
|  | Trolley jacks | For lifting engines | 2 | 1:13 |
|  | Dial gauge | For testing components | 2 | 1:13 |
|  | Vee blocks | For supporting components | 5 sets | 1:5 |
|  | Engineer’s Surface plate | For supporting dial gauge | 2 | 1:13 |
|  | Dust bin | For dust collecting | 3 | 1:9 |
|  | Waste oil tank | For collecting waste oil | 1 | 1:25 |
| **E** | **PPE (Personal Protective Equipment)** |  |  |  |
| 1 | PPE Sets | Includes gloves, safety boot, and overall/ dust bin | 25 sets | 1:1 |
| 2 | Safety Signs and Barriers | For simulating safety zones and hazards | 10 sets | 1:2.5 |
| 3 | Wheel chokes | For choking wheels while servicing | 8 pieces | 1:3 |
|  |  |  |  |  |
| **F** | **Reference Materials** |  |  |  |
| 1 | Engine manuals | Covering principles and practices in automation | 25 pcs | 1:1 |
| 3 | Technical Handbooks | On vehicle engine service | 25 pcs | 1:1 |
| 4 | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
| 5 | Multimedia Learning Modules | Digital licenses for videos and tutorials | 25 pcs | 1:1 |
| 6 | Practical Assessment Guides | Worksheets for practical assessments | 25 pcs | 1:1 |