

**REPUBLIC OF KENYA**

**COMPETENCY BASED MODULAR CURRICULUM**

**FOR**

**AUTOMOTIVE ENGINEERING TECHNOLOGY**

**KNQF LEVEL 6**

**PROGRAMME ISCED CODE: 0716 554A**

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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 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).

TVET Act, 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 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 Sector acquire competencies to perform their work more efficiently and effectively.

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# ABBREVIATIONS AND ACRONYMS

TVET Technical, Vocational Education and Training

KNQA Kenya National Qualifications Authority

TVETA TVET Authority

ISCED International Standard Classification of Education

KCSE Kenya Certificate of Secondary Education

CPU Central Processing Unit

RAM Random Access Memory

DVD Digital Versatile Disc

CD Compact Disc

USB Universal Serial Bus

PIN Personal Identification Number

**KEY TO ISCED UNIT CODE**



# COURSE OVERVIEW

The Automotive Engineering Technology Level 6 curriculum consists of competencies that a person must achieve to enable him/her to service and maintain motor vehicles in the motor vehicle industry. It includes maintaining vehicle engine, maintaining vehicle transmission system, maintaining vehicle braking system, maintaining vehicle suspension and steering system, maintaining vehicle fuel system, maintaining automotive electrical systems, maintaining electric vehicle power train, maintaining vehicle comfort system and maintaining vehicle safety and security system.

The units of competency comprising Automotive Engineering Technician Certificate Level 6 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 | Maintain Vehicle Diesel Engine | 180 | 18.0 |
| 0716 551 04A | Maintain Vehicle Suspension and steering system | 160 | 16.0 |
| **MODULE III** | | | |
| **BASIC UNIT OF LEARNING** | | | |
| 0031 441 05A | Communication Skills | 40 | 4.0 |
| 0417 541 06A | Apply work ethics and practices | 40 | 4.0 |
| **COMMON UNIT OF LEARNING** | | | |
| 0541 441 07A | Apply Mathematics | 80 | 8.0 |
| 0732 441 08A | Technical Drawing | 80 | 8.0 |
| **CORE UNITS OF LEARNING** | | | |
| 0716 451 09A | 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 |
| **MODULE V** | | | |
| **COMMON UNIT OF LEARNING** | | | |
| 0541 541 17A | Engineering Mathematics | 100 | 10.0 |
| 0732 541 18A | Computer Aided Drawing | 120 | 12.0 |
| **CORE UNITS OF LEARNING** | | | |
| 0716 551 19A | Hybrid and Electric Vehicle | 200 | 20.0 |
| **MODULE VI** | | | |
| **COMMON UNIT OF LEARNING** | | | |
| 0715 541 20A | Engineering Mechanics | 80 | 8.0 |
| **CORE UNITS OF LEARNING** | | | |
| 0716 551 21A | Vehicle Safety and Security System Maintenance | 200 | 20.0 |
| **MODULE VII** | | | |
| **COMMON UNIT OF LEARNING** | | | |
| 0715 541 22A | Thermodynamics and Fluid Mechanics | 140 | 14.0 |
| **CORE UNITS OF LEARNING** | | | |
| 0716 551 23A | Vehicle Comfort System Maintenance | 200 | 20.0 |
| **Industrial Attachment** | | **480** | **48.0** |
| **GRAND TOTAL** | | **3110** | **311.0** |

**Entry Requirements**

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

1. Kenya Certificate of Secondary Education (KCSE) mean grade C- (minus) or KCE Division III

Or

1. KACE 1 Principal and 1 Subsidiary

Or

1. Automotive Technology KNQF level 5 certificate

Or

1. 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 7 certificate in Automotive Engineering Technician or its equivalent.
2. Licensed 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 an industrial attachment for a minimum period of 480 hours in an automotive industry.

**Assessment**

This course will be assessed in both formative and summative as follows;

1. During formative assessment, all performance criteria shall be assessed based on performance criteria weighting.
2. Summative assessment shall focus on critical aspects of the unit of competency.
3. Theory and practical weight shall be as follows:
4. 10:90 for unit in module 1 and module 2 for each unit of learning.
5. 30:70 for units in module 3 and module 4 for each unit of learning.
6. 40:60 for units in module 5 and 6 for each unit of learning.
7. Formative and summative assessment weight shall constitute 60% and 40% of the overall score, respectively.
8. For a candidate to be declared competent in a unit of competency, a candidate shall meet the following conditions:
9. Obtained at least 40% in theory assessment in formative and summative assessments
10. Obtained at least 50% 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 and the latter 40% of the overall score.
12. Assessment performance rating for each of the unit of competence shall be as follows:

|  |  |
| --- | --- |
| **MARKS** | **COMPETENCE RATING.** |
| 80-100 | Mastery |
| 65-79 | Proficiency |
| 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 KenyaNational TVET Certificate in Automotive Engineering Technology KNQF Level 6, 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 topping up      7. Coolant topping 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. Importance   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 systems

**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 |
| TOTAL | | 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. Importance   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. Micrometer         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. Vehicle Suspension and Steering System Diagnosis | * 1. Work area organization and maintenance      1. Setting up the work area      2. Storage and labelling of tools, equipment and materials      3. Proper housekeeping   2. Tools, equipment and materials      1. Uses of steering and suspension system tools      2. Safe handling techniques      3. Maintenance of tools, equipment and materials   3. Steering and suspension system assessment      1. Steering system construction and operation      2. Steering system components   4. Suspension and steering system diagnosis      1. Diagnostics trouble codes      2. Trouble code interpretation   5. Service and replacement of steering and suspension system sensors and actuators      1. Sensors, (steering angle, torque, position and speed sensors) actuators and circuit tests(s      2. Faulty sensors and actuator tests   6. Preparation of suspension and steering system service documents | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Vehicle Suspension System | * 1. Work area organization and maintenance      1. Setting up the workplace      2. Proper storage and labelling of tools, equipment and materials   2. Suspension system service safety precautions      1. Hazards when servicing suspension systems      2. Safety precautions when servicing suspension systems      3. Types and uses of PPEs   3. Tools, equipment and materials for vehicle suspension systems      1. Uses of suspension system tools      2. Safe handling techniques      3. Maintenance of tools, equipment and materials      4. Types of suspension systems         1. Non independent suspension         2. Independent suspension         3. Hydrolastic         4. Hydra gas         5. Hydro pneumatic         6. Air suspension         7. Rubber   4. Vehicle suspension system diagnosis      1. Suspension system inspection      2. Serviceability         1. Tolerances         2. Leakage         3. Wear         4. Corrosion         5. Damage   5. Suspension system components inspection      1. Seals      2. Shims      3. Fittings      4. Fasteners      5. Bushes      6. springs   6. Service/replacement of vehicle suspension components      1. Seals      2. Shims      3. Fittings      4. Fasteners      5. Bushes      6. Springs      7. Suspension system reinstallation checks   7. Preparation of vehicle suspension system service documents | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Vehicle Steering System | * 1. Work area organization and maintenance      1. Setting up the workplace      2. Proper storage and labelling of tools, equipment and materials   2. Steering system service safety measures   3. Types of steering systems      1. Manual Steering System      2. Electrical motor      3. Power assisted steering   4. Functions of steering system   5. Steering systems components (Steering wheels, column, shaft, gearbox, tie rods, steering knuckle, steering pump, electric motor, sensors)   6. Steering systems layouts   7. Steering geometry      1. Ackerman’s principle      2. Camber      3. Castor      4. Toe in toe out   8. Types of steering systems      1. Conventional      2. Twin-axle   9. Steering system diagnosis   10. Steering system inspection       1. Serviceability;       2. Tolerances;       3. Leakage       4. Wear       5. Corrosion       6. Damage   11. Steering system components service/replacement       1. Steering rack       2. Steering gearboxes       3. Drag link       4. Drop arm       5. Track rods       6. Track arm   12. Steering system assembly and testing       1. System service documentation | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Vehicle Wheels and Tyres | * 1. Work area organization and maintenance Setting up the workplace      1. Proper storage and labelling of tools, equipment and materials   2. Tools and equipment      1. Digital wheel balancing machine      2. Digital wheel alignment machine   3. Types of wheels and tyres      1. Steel and aluminium      2. Flat base      3. Well base      4. Divided      5. Two pieces      6. Three pieces      7. Cross ply      8. Radial ply      9. Belted      10. Tubed and tubeless      11. Run flat tyres      12. Self-sealing   4. Tyre construction      1. Beads      2. Bead filler      3. Radial cord body      4. Inner liner      5. Tread      6. Sidewall      7. Belt plies   5. Tyre specification      1. Pressure rating      2. Aspect ration      3. Width      4. Diameter      5. Speed   6. Tubes      1. Sizes      2. Nozzles      3. Coding   7. Tyre repair   8. Wheel balancing   9. Wheel rotation   10. Tread wear marks | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Vehicle Wheel Alignment | * 1. Work area organization and maintenance      1. Setting up the workplace      2. Proper storage and labelling of tools, equipment and materials   2. Tools, equipment and materials      1. Digital wheel balancing machine      2. Digital wheel alignment machine      3. Optic wheel alignment machine   3. Wheel alignment procedure   4. Wheel alignment documentation | * Practical * Project * Portfolio of evidence * Third party report * Written tests |

# 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 |
| TOTAL | | 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 |
| TOTAL | | 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 |
| TOTAL | | 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 441 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 |
| TOTAL | | 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

**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 |
|  | | 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 |
| TOTAL | | 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 |
| TOTAL | | 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 |  | 5 | 1:5 |
|  | Gas welding machine |  | 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 |  |  |  |
| **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**: **80 Hours**

**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 |

# MODULE V

# COMMON UNITS OF LEARNING

# ENGINEERING MATHEMATICS

**Unit Code:** 0541 541 17A

**Unit Duration:** 100 Hours

**Relationship to Occupational Standards**

**This unit addresses the Unit of Competency:** Apply Engineering Mathematics

**Unit Description**

This unit describes the competences required in order to apply engineering mathematics. It enables the learner to; Apply complex numbers, perform coordinate geometry, carry out binomial expansion, apply calculus, apply vector theorem and Apply matrices

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Apply complex numbers | 10 |
|  | Perform coordinate geometry | 10 |
|  | Carry out binomial expansion | 20 |
|  | Apply calculus | 40 |
|  | Apply vector theorem | 10 |
|  | Apply matrices | 10 |
|  | | 100 |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply complex numbers | * 1. Complex geometry      1. Real part      2. Imaginary part      3. Argand diagram      4. Modulus/Magnitude      5. Argument /Angle      6. Conjugate   2. Operations      1. Addition      2. Subtraction      3. Multiplication      4. Division      5. Conversions         1. Polar form to rectangular form         2. Rectangular form to polar form   3. De Moivre’s theorem      1. Expansion of complex numbers      2. Roots of complex numbers      3. Trigonometric identities using complex numbers | * Written tests |
| 1. Perform coordinate geometry | * 1. Cartesian geometry      1. Cartesian plane         1. x and y axes         2. Positive and negative coordinates      2. Gradient         1. Positive         2. Negative         3. Zero         4. Infinite         5. Gradients of parallel line         6. Gradients of perpendicular lines      3. y-intercept   2. Linear equations      1. Straight line      2. Parallel lines      3. Perpendicular lines   3. Graphs of linear equations      1. Straight lines   4. Polar geometry      1. Magnitude      2. Direction      3. Graphs   5. Conversions      1. Linear to polar      2. Polar to linear   6. Solving polar equations | * Written tests |
| 1. Carry out binomial expansion | * 1. Binomial series      1. Powers      2. Coefficients      3. Pascals triangle      4. Expansion   2. Binomial theorem      1. Positive powers of n      2. Negative powers of n      3. Fractional powers of n (roots)      4. Estimation of errors of small changes | * Written tests |
| 1. Apply calculus | * 1. Differentiation up to third order      1. Functions         1. Linear         2. Trigonometric         3. Logarithmic         4. Exponential      2. Rules         1. Power         2. Product         3. Chain         4. Quotient      3. Applications         1. Stationary points         2. Rates of change   2. Integration      1. Standard integral      2. Definite integral      3. Techniques         1. By parts         2. Substitution         3. Partial fractions      4. Applications         1. Area between and under curves         2. Volume      5. Differential equation      6. Double and triple integral      7. Laplace transform      8. Fourier series | * Written tests |
| 1. Apply vector theorem | * 1. Differentiate between vector and scalar quantities      1. Magnitude      2. Direction         1. Positive         2. Negative   2. Operation on vectors      1. Addition      2. Subtraction      3. Dot product      4. Cross product   3. Resolution of vectors      1. Analysis      2. Graphical Methods         1. Triangle theorem         2. Parallel theorem         3. Polygon theorem | * Written tests |
| 1. Apply matrices | * 1. Matrices      1. Types         1. Row         2. Column         3. Square         4. Zero         5. Identity         6. Diagonal   2. Matrices operations (up to 3 x 3)      1. Addition      2. Subtraction      3. Multiplication   3. Inverse of matrices (up to 3 x 3)      1. Determinant      2. Transpose      3. Adjoint      4. Inverse   4. Simultaneous equations   (up to 3 equations)   * + 1. Inverse method     2. Crammers Rule     3. Row reduction | * Written tests |

**Suggested Delivery Methods**

* Demonstration
* Group discussions
* 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 |
|  | Brooms and cleaning stuff | Hand brooms and mops for cleaning | 10 | 2:5 |
| **D** | **Tools and Equipment** | | | |
|  | Set of Mathematical instruments | For constructions and measurements | 30 | 1:1 |
|  | Firefighting extinguishers | Water, carbon dioxide and chemical powder fire extinguishers for fire fighting | 1 | 1:30 |
| **F** | **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 |

# COMPUTER AIDED DRAWING

**UNIT CODE:** 0732 541 18A

**UNIT DURATION:** 120 HOURS

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform computer aided drawing.

**Unit description**

This unit covers the competences required to perform computer aided drawing. It involves navigating CAD software, producing geometric, pictorial, orthographic and assembly drawings as well as designing mechanical components.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Navigate CAD software | 10 |
|  | Produce geometric drawings | 10 |
|  | Produce pictorial drawings | 20 |
|  | Produce orthographic drawings. | 30 |
|  | Produce assembly drawings | 30 |
|  | Design mechanical components | 30 |
| TOTAL | | 120 |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Navigate CAD software | * 1. Overview of CAD      1. Definition and significance of CAD in engineering and design.      2. Historical development of CAD technologies.   2. Computing Equipment and Software      1. Identify hardware requirements for CAD operations.      2. List popular CAD software options (e.g., AutoCAD, SolidWorks, Inventor).   3. Drawing CAD Software      1. Overview of the software interface.      2. Functions and capabilities of CAD tools.   4. CAD Software Templates      1. Explore various templates available for different drawing requirements.   5. Importing CAD Files      1. Process of importing files (DWG, STL, DXF, STEP) into the working space.   6. User Interface Navigation      1. Familiarization with the CAD software interface.      2. Understanding toolbars, menus, and command lines.   7. Setting Up the Drawing Environment      1. Units and measurement settings.      2. Creating a new drawing and saving files.   8. Symbols, Codes, and Standards      1. Identify relevant symbols and codes according to software functionality.   9. Understand and utilize drawing Elements      1. Points      2. Line angles      3. Circles and arcs      4. Planes (horizontal, vertical)      5. Figures and solids      6. Shapes      7. Objects snapping settings      8. Polar tracking settings.      9. Orthomode utilization   10. Use editing commands Editing Tools       1. Delete, undo and redo commands       2. Fillet and chamfer commands       3. Trim, extend and break commands       4. Zoom and pan commands       5. Move, copy, and paste commands       6. Rotate and mirror commands       7. Object snapping and grouping commands       8. Dimension and scaling commands | 1. Written tests 2. Oral Questioning 3. Portfolio of evidence |
| 1. Produce geometric drawings | * 1. Setting Drawing Lines      1. Recognize standard drawing line conventions * Dimension lines * Hidden detail lines * Extension lines * Section lines * Break lines * Chain   1. Using drawing lines   2. Constructing Types of Angles      1. Use trigonometry principles to construct acute, obtuse, and right angles.   3. Constructing Geometrical Forms      1. Create circles, rectangles, triangles, and polygons according to standards.   4. Developing Geometric Drawings      1. 2-Dimensional      2. Orthographic      3. Isometric |  |
| 1. Produce pictorial drawings | * 1. Drawing Symbols and Abbreviations      1. Apply standard drawing symbols and abbreviations in pictorial drawings.   2. Producing Pictorial Drawings      1. Techniques for creating isometric, oblique, cabinet, and cavalier drawings.   3. Saving Pictorial Drawings      1. Procedures for saving drawings in appropriate formats. |  |
| 1. Produce orthographic drawings. | * 1. Fundamentals of Orthographic Projection      1. Definition and importance of orthographic drawing.      2. Differences between orthographic and other drawing types (isometric, perspective).   2. Types of Orthographic Projections      1. First-angle projection.      2. Third-angle projection.   3. Understanding Views      1. Front, top, and side views.      2. Additional views (sectional, auxiliary).   4. First Angle Orthographic Drawings      1. Develop first-angle drawings adhering to standard conventions.   5. Third Angle Orthographic Drawings      1. Create third-angle drawings based on standard practices.   6. Saving Orthographic Drawings      1. Techniques for properly saving orthographic drawings.   7. Dimensioning Orthographic Views   8. Printing orthographic views   9. Creating isometric drawing      1. Choosing isometric cursor      2. Dimensioning isometric drawing      3. Printing isometric drawing   10. Creating 3D model       1. Choosing 3D workspace       2. 3D workspace modifying tool (3D orbit, 3D mirrors, union, extrude, press pull, e.t.c)       3. Rendering       4. Pring 3D models |  |
| 1. Produce assembly drawings | * 1. Overview of Assembly Drawings      1. Definition and purpose of assembly drawings.      2. Importance in manufacturing and engineering.   2. Types of Assembly Drawings      1. General assembly drawings vs. detailed assembly drawings.      2. Exploded view vs. isometric assembly drawings.   3. Exploding Orthographic Views      1. Techniques for exploding views in accordance with standard conventions.   4. Exploding Pictorial Views      1. Create exploded pictorial views based on drawing specifications.   5. Assembling Views      1. Assemble orthographic and pictorial views accurately.   6. Producing Sectional Views      1. Generate sectional views according to drawing standards.   7. Developing Parts List      1. Creating a parts list based on the drawing schematic. |  |
| 1. Design mechanical components | * 1. Designing Mechanical Components      1. Apply CAD principles to design mechanical components per work requirements.   2. Applying CAE in Simulation      1. Use computer-aided engineering tools for simulating mechanical designs.   3. Determining Improvements      1. Analyze design results to identify efficiency improvements.   4. Creating a Manufacturing Database      1. Develop a database to support the manufacturing process.   5. Improving Design Documents      1. Make enhancements to design documents based on manufacturing feedback.   6. Practical Activity |  |

**Suggested Delivery Methods**

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

**Recommended resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item)** |
| **A** | **Learning Materials** |  |  |  |
| 1 | Textbooks | Comprehensive texts on CAD basics, history, and hardware requirements. | 5 pcs | 1:5 |
| 2 | Charts | Visual aids covering CAD software evolution and industry applications. | 10 pcs | 1:2.5 |
| 3 | PowerPoint Presentations | For trainer’s use, covering CAD definitions, history, and hardware requirements. | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
| 1 | Lecture/Theory Room | Equipped with projector, seating for 25 trainees, ~60 sqm. | 1 | 1:25 |
| 2 | Computer Laboratory | Equipped with 25 computers installed with CAD software, ~80 sqm. | 25 | 1:1 |
| 3 | Printer/plotter | For printing CAD drawings | 2 | 1:13 |
| 4 | 3D printer | For printing 3D models | 2 | 1:13 |
| 5 | 3D printer filament | 3D printing material | 2 rolls | 1:13 |
| **C** | **Consumable Materials** |  |  |  |
| 1 | USB Drives | For storing and transferring CAD project files. | 25 pcs | 1:1 |
| 2 | Notebooks | For trainees to take notes during CAD sessions. | 25 pcs | 1:1 |
| **D** | **Tools and Equipment** |  |  |  |
| 1 | Computers | Equipped with CAD software and compatible hardware (e.g., high RAM, graphics support). | 25 pcs | 1:1 |
| 2 | Projector | For displaying CAD software demonstrations and presentations in lecture room. | 1 | 1:25 |
| 3 | External Hard Drives | For backing up CAD files and course materials. | 5 pcs | 1:5 |
| 4 | Drawing Tablets | For CAD software use, supporting stylus input for design precision. | 5 pcs | 1:5 |
| **E** | **Reference Materials** |  |  |  |
| 1 | CAD Software Manuals | Documentation detailing CAD software functionalities and hardware requirements. | 25 pcs | 1:1 |
| 2 | CAD Industry Case Studies | Case studies showcasing CAD applications in engineering and design. | 5 pcs | 1:5 |
| 3 | Practical Assessment Guides | Worksheets for practical assessments on CAD navigation and hardware requirements. | 25 pcs | 1:1 |
| 4 | Training Presentations/Slides | Digital format for shared access among trainees covering CAD course content. | 1 | 1:25 |

# CORE UNITS OF LEARNING

# HYBRID AND ELECTRIC VEHICLE MAINTENANCE

**UNIT CODE: 0716 551 19A**

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency Maintain electric and hybrid vehicle

**Duration of Unit: 200** Hours

**Unit Description**

This unit specifies competencies required to maintain electric and hybrid vehicle. It includes servicing electric vehicle batteries, servicing electric vehicle low voltage systems, servicing electric vehicle high voltage systems and servicing electric vehicle electronic systems.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Service Electric Vehicle Batteries | 50 |
|  | Service Electric Vehicle Low Voltage Systems | 50 |
|  | Service Electric Vehicle High Voltage Systems | 50 |
|  | Service Electric Vehicle Electronic Systems | 50 |
|  | | 200 |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Service Electric Vehicle Batteries | * 1. Introduction to Electric Vehicle (EV)      1. History of EVs      2. Early EV development      3. Modern vehicle      4. Case study of Kenya      5. Factors affecting EV adoption      6. History of modern storage battery   2. Types of EVS      1. Electrified Vehicles      2. Plug-in-Hybrid EVs (PHEV)      3. Battery Electric Vehicle (BEV)      4. Hybrid Electric Vehicle (HEV)   3. Types of charging systems      1. AC Charging      2. DC Charging   4. Work area organization and maintenance      1. Setting up the work place      2. Proper waste disposal of batteries electrolyte and toxic substances as per EMCA 1999      3. Hazards associated with electric and hybrid vehicles      4. Safety precautions when servicing electric and hybrid vehicles      5. Types and uses of PPEs      6. Proper house keeping   5. Safety measures      1. Relevant statutory regulations in performing EV work      2. Potential accidents and their causes      3. Personal safety      4. Safety of tools and equipment      5. First Aid      6. Fire fighting   6. Tools and equipment      1. Diagnostic & testing tools      2. Electrical safety equipment      3. Battery tools      4. EV specific tools      5. General workshop Hand tools and equipment      6. Software, IT equipment and infrastructure      7. Maintenance and repair of EV production tools and equipment   7. Components of an EV battery      1. Battery management system      2. Battery control unit      3. Battery cells      4. Mechanical packaging      5. System control electronics      6. Battery connectors      7. Battery software and controls   8. Types of EV batteries and chemistry basics      1. Lead acid      2. Nickel metal based      3. Lithium-Ion batteries      4. Sodium based chemistries   9. Safe handling of an EV battery      1. Thermal management      2. Overcurrent      3. Over-voltage      4. Safe storage      5. Battery cooling system      6. Electromagnetic disturbance   10. Methods of maintaining an EV battery       1. Measuring state of charge       2. Conducting charging test and discharge test       3. Regular cleaning       4. Proper storage       5. Periodic inspection (e.g., checking physical damage)       6. Load testing   11. Management of battery performance and lifecycle       1. Battery range       2. Monitoring and diagnostics       3. Charging practises       4. Tracking state of Health/state of charge       5. stages of EV battery life       6. Recycling and disposal of EV batteries   12. state of charge battery calibration       1. Inspection for damaged battery cells       2. Measuring voltage & internal resistance       3. Repeated cycles of charging & discharging of the cells       4. Programming battery management system   13. quality control checks on the battery       1. software updates & functionality       2. charge & discharge test       3. physical checks       4. electrical inspection       5. Check for connectivity | * Written tests * Practical * Project * Portfolio of evidence * Third party report |
| 1. Service Electric Vehicle Low Voltage Systems | * 1. Work area organization and maintenance      1. Setting up the work place      2. Proper storage and labelling of tools equipment and materials      3. Hazards associated with low voltage system      4. Safety precautions when servicing low voltage system      5. Types and uses of PPEs      6. Proper house keeping   2. Tools and equipment   3. Components, functions and operation of low voltage EV systems      1. 12/6v battery      2. DC to DC converter      3. Alternator      4. Electrical components         1. Lights         2. wiring harness         3. Indicators         4. Wipers         5. Power windows         6. Audio system         7. Telematics         8. Infotainment systems   4. Troubleshooting low voltage system      1. Identify the defective system      2. continuity/resistance and voltage of the system      3. faulty electrical components/ wiring      4. Document the findings   5. quality control on low voltage EVs      1. Identify appropriate checklist      2. Conduct functional tests      3. Monitor performance      4. Document the findings | * Written tests * Practical * Project * Portfolio of evidence * Third party report |
| 1. Service Electric Vehicle High Voltage Systems | * 1. Work area organization and maintenance      1. Setting up the work place      2. Proper storage and labelling of tools equipment and materials      3. Hazards associated with high voltage system      4. Safety precautions when servicing high voltage system   2. Types and uses of PPEs   3. Proper house keeping   4. Tools and equipment   5. Components, functions and operation of high voltage EV systems      1. High voltages battery pack      2. Battery Management System (BMS)      3. Traction motor      4. Inverter/controller      5. Onboard charger      6. High voltage wiring harness      7. Electric powertrain   6. Safety measures when handling high voltage EV systems   7. Troubleshooting high voltage system   8. Repairing high voltage system on Electric vehicle   9. Performing quality control      1. Identify appropriate checklist      2. Conduct functional tests      3. Monitor performance      4. Document the findings | * Written tests * Practical * Project * Portfolio of evidence * Third party report |
| 1. Service Electric Vehicle Electronic Systems | 4.1 Work area organization and maintenance   * + 1. Setting up the work place     2. Proper waste disposal of Electronic Systems.     3. Hazards associated with Electronic Systems     4. Safety precautions when servicing Electronic Systems     5. Safety measures when handling electronic systems     6. Types and uses of PPEs   1. Proper house keeping   2. Components, functions and operations of EV electronic systems      1. Power Electronics         1. Battery Management System (BMS)         2. Inverters         3. Onboard charger         4. DC-DC converter      2. Motor Control Unit (MCU)      3. Telematics and Connectivity      4. Basic advanced driver assist system      5. Human machine interface   3. Troubleshooting electronic systems   4. Repairing electronic systems   5. Quality control checks on the EV electronic systems | * Written tests * Practical * Project * Portfolio of evidence * Third party report |

**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. | 10 pcs | 1:2.5 |
| 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 | 10 | 1:2.5 |
|  |  |  |  |  |
| **C** | **Consumable Materials** | | | |
|  | First aid kit |  | 5 pieces | 1:5 |
|  | Battery sulphuric acid | For replacing during service | 10 litres | 1:2.5 |
|  | Distilled water | For replacing during service | 10 litres | 1:2.5 |
|  | Insulating tape | For repairing components |  |  |
|  | Soldering wire | For repairing components |  |  |
|  | Paraffin | For cleaning components during services | 10 litres | 1:2.5 |
|  | Cable ties |  |  |  |
|  | Switches | For replacing during service | 5 pcs | 1:5 |
|  | Cotton waste | For cleaning components | 1 bag | 1:25 |
|  |  |  |  |  |
| **D** | **Tools and Equipment** |  |  |  |
|  | Complete fully electric vehicle | For servicing electrical components | 1 | 1:25 |
|  | Complete hybrid Vehicle | For demonstrations | 1 | 1:25 |
|  | Test lamp/multimeter | For testing | 5 | 1:5 |
|  | Battery charger | For charging battery | 2 | 1:12.5 |
|  | Spark plug testing machine | For testing spark plug functionality | 2 | 1:12.5 |
|  | 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 | 1:12.5 |
| **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 | 1:2 |
|  |  |  |  |  |
| **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 |
| 5 | Multimedia Learning Modules | Digital licenses for videos and tutorials | 25 pcs | 1:1 |
| 6 | Practical Assessment Guides | Worksheets for practical assessments | 25pcs | 1:1 |

# MODULE VI

# ENGINEERING MECHANICS

**UNIT CODE: 0715 541 16A**

**Relationship to Occupational Standards**: Apply Engineering Mechanics

**Duration of Unit**: 80 Hours

**Unit Description**

This unit of competency describes the competences required in order to apply engineering mechanics principles. This includes, applying simple mechanisms, designing belts, ropes and chain drives, designing toothed gears and gear trains, designing mechanical rotor dynamic machines, applying stress and strain concepts, determining loading conditions, applying simple bending theory and applying torsion theory in mechanical systems.

**Summary of Learning Outcomes**

By the end of this unit, trainees should be able to;

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcome** | **Duration (Hours)** |
|  | Simple Mechanisms | 10 |
|  | Belts, Ropes and Chain Drives | 10 |
|  | Toothed Gears and Gear Trains | 10 |
|  | Mechanical Rotor Dynamic Machines | 10 |
|  | Stress And Strain Concepts in Mechanical Systems | 10 |
|  | Loading Conditions in Mechanical Systems | 10 |
|  | Simple Bending Theory in Mechanical Systems | 10 |
|  | Torsion Theory in Mechanical Systems | 10 |
| **Total** | | **80** |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. simple mechanisms | * 1. Define simple mechanism   2. Components of simple mechanism      1. Link      2. Element   3. Types of mechanisms      1. Single slider mechanism      2. Double slider mechanism | * Written Tests |
| 1. belts, ropes and chain drives | * 1. Definition      1. Belt      2. Rope      3. Chain   2. Belts      1. Material used for belt         + 1. Rubber           2. Cotton           3. Leather      2. Types of belts   2.2.2.1 Flat  2.2.2.2 V belt  2.2.2.3 Circular   * + 1. Configuration of belt drive   2.2.3.1Open   * + - 1. Crossed     1. Design Analysis of Flat and V-Belts   2.2.4.1Velocity ratio   * + - 1. Length of belt       2. Angle of contact       3. Power transmitted   1. Rope Drives      1. Types of rope drives   2. Chain Drives      1. Types of chain drives | * Written Tests |
| 1. toothed gears and gear trains | * 1. Types of Gears      1. Spur      2. Helical      3. Double helical   2. Types of Gear Trains      1. Simple gear train         1. Design calculations      2. Compound gear train         1. Design calculations      3. Reverted gear train         1. Design calculations      4. Epicyclic gear train   3. Lubrication of gears | * Written Tests |
| 1. Design mechanical rotor dynamic machines | * 1. Types of pumps and operation principle      1. Reciprocating pump      2. Centrifugal pump   2. Derivation of equations for      1. Reciprocating pumps      2. Centrifugal pumps   3. Analysis of pumps      1. Discharge      2. Efficiency      3. Power      4. Head      5. Weight per unit   4. Types and operation principle of rotary compressors      1. Rotary screw compressors      2. Rotary vane compressors      3. Scroll compressor      4. Rotary lobe   5. Analysis of compressors      1. Inlet and outlet flow      2. Work done      3. Mass flow rate      4. Power requirement      5. Efficiency   6. Compressor Fans and Vanes      1. Structure and functions of compressor fans and vanes      2. Operation principles of fans and vanes in rotary compressors      3. Maintenance of fans and vanes   7. Design Analysis      1. Vane efficiency      2. Fan efficiency      3. Power consumption | * Written Tests |
| 1. Apply stress and strain concepts in mechanical systems | * 1. Define stress and strain   2. Types of simple stresses      1. Direct      2. Shear      3. Ultimate tensile stress      4. Yield stress      5. Breaking stress      6. True stress   3. Analysing stress on      1. Beams      2. Thin cylinders      3. Thin shells   4. Applications of stress and strain concepts      1. Bolts and nuts      2. Shafts | * Written Tests |
| 1. Determine loading conditions in mechanical systems | * 1. Define structure   2. Types of loading      1. Point load      2. Uniformly distributed load      3. Varying load   3. Types of beams      1. Simply supported beams      2. Cantilever beam   4. Overhanging beam |  |
| 1. Apply simple bending theory in mechanical systems | * 1. Engineers Bending Equation   2. Types of Beams      1. Simply supported beams      2. Cantilever beam      3. Overhanging beam   3. Analysis of Beams      1. T-section      2. L-section      3. I-section   4. Types of Shafts      1. Solid      2. Tubular      3. stepped   5. Analysis of shafts      1. Solid      2. Tubular      3. Stepped | * Written Tests |
| 1. Apply torsion theory in mechanical systems | * 1. Define Torsion   2. Torque Analysis   3. Analysis of Shafts      1. Series arranged shafts      2. Parallel arranged shafts   4. Determine angle of twist      1. Engineers’ torsion equation | * Written tests |

**Suggested Delivery Methods**

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

**Recommended resources for 25 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 |
|  | Brooms and cleaning stuff | Hand brooms and mops for cleaning | 10 | 2:5 |
| **D** | **Tools and Equipment** | | | |
|  | Calculators | For calculations | 30 | 1:1 |
|  | Firefighting extinguishers | Water, carbon dioxide and chemical powder fire extinguishers for fire fighting | 1 | 1:30 |
| **F** | **Reference Materials** | | | |
|  | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:30 |

T

# CORE UNITS OF LEARNING

# **VEHICLE SAFETY AND SECURITY** SYSTEM MAINTENANCE

**UNIT CODE: 0716 551 21A**

**UNIT DURATION: 200** Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency maintain vehicle safety and security system.

**Unit Description**

This unit specifies the competencies required to maintain vehicle safety and security system. It includes servicing vehicle safety system, servicing vehicle security system and carrying out vehicle safety and security system diagnosis

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | To Service Vehicle safety system | 70 |
|  | To Service Vehicle security system | 50 |
|  | To Carry out vehicle safety and security system diagnosis | 80 |
|  | | 200 |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1 Service Vehicle safety system | * 1. Vehicle safety system safety measures   2. Tools and equipment      1. Socket set      2. Pliers      3. On board diagnostic kite   3. Types of Vehicle safety system:      1. Alarms      2. First Aid Kit      3. Blind Spot Mirrors      4. Dash Cam      5. Backup Camera      6. Alarm and signaling System      7. Tire Pressure Monitoring System (TPMS)      8. Safety bet      9. Air bags      10. Vehicle track      11. Central door locking system   4. Vehicle safety system construction and operation of:      1. Air bags      2. Seat belts and buckles      3. Central door locking system      4. Alarm and signaling System’   5. Installation of :      1. Dash Cam      2. Backup Camera   6. Vehicle safety components assessment/service/replacement      1. Air bags      2. Seat belts and buckles      3. Central door locking system      4. Alarm and signaling System’   7. Vehicle safety system service documentation | * Assignments * Oral questioning * Practical tests * Supervised exercises * Written tests   Projects  Portfolio of evidence. |
| 2 Service Vehicle security system | * 1. Vehicle security system safety measures   2. Tools and equipment      1. Socket set      2. On board diagnostic kit   3. Vehicle security system components assessment/install/service/replacement      1. Steering wheel locks      2. Alarm      3. Immobilizers      4. Remote locks      5. Satellite trackers      6. Smart keys   4. Vehicle security system service documentation | 1. Assignments 2. Oral questioning 3. Practical tests 4. Supervised exercises 5. Written tests 6. projects 7. Learner portfolio of evidence. |
| 3 Carry out vehicle safety and security system diagnosis | * 1. Tools, equipment and materials      1. Socket set      2. Pliers      3. On board diagnostic kit      4. Alarms      5. First Aid Kit   2. Vehicle safety components      1. Blind Spot Mirrors      2. Dash Cam      3. Backup Camera      4. Alarm and signaling System      5. Tire Pressure Monitoring System (TPMS)      6. Safety bet      7. Air bags   3. Vehicle safety and security systems diagnosis      1. On board diagnostic kit      2. Trouble codes      3. Sensors      4. Actuators      5. circuits      * 1. Vehicle safety and security systems components assessment/service/installation/replacement      1. Steering wheel locks      2. Alarm      3. Immobilizers      4. Remote locks      5. Satellite trackers      6. Smart keys      7. Air bags      8. Seat belts and buckles      9. Central door locking system      10. signaling System’      11. Sensors      12. Actuators      13. circuits   2. Vehicle security system service documentation | 1. Assignments 2. Oral questioning 3. Practical tests 4. Supervised exercises 5. Written tests 6. projects 7. Learner portfolio of evidence. |

**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. | 10 pcs | 1:2.5 |
| 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 | 10 | 1:2.5 |
|  |  |  |  |  |
| **C** | **Consumable Materials** | | | |
|  | First aid kit |  | 5 pieces | 1:5 |
|  | Insulating tape | For repairing components |  |  |
|  | Soldering wire | For repairing components |  |  |
|  | Paraffin | For cleaning components during services | 10 litres | 1:2.5 |
|  | Cable ties |  |  |  |
|  | Switches | For replacing during service | 5 pcs | 1:5 |
|  | Cotton waste | For cleaning components | 1 bag | 1:25 |
|  |  |  |  |  |
| **D** | **Tools and Equipment** |  |  |  |
|  | Complete vehicle | For servicing security and safety components | 1 | 1:25 |
|  | 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 | 1:12.5 |
| **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 | 1:2 |
|  |  |  |  |  |
| **F** | **Reference Materials** |  |  |  |
| 1 | vehicle manuals | Covering principles and practices in vehicle electrical system | 25 pcs | 1:1 |
| 3 | Technical Handbooks | On vehicle security 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 | 25pcs | 1:1 |

# MODULE VII

# **COMMON UNIT OF LEARNING**

# THERMODYNAMICS AND FLUID MECHANICS

**UNIT CODE: 0715 541 22A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: apply mechanical technology principles

**Duration of Unit**: 140 hours

**Unit Description**

This unit describes the competences required in order to apply thermodynamics and fluid mechanics in their work. It includes; apply Thermodynamic Processes, apply knowledge of perfect gases, apply knowledge of steam cycle, apply knowledge of fuel combustion, apply heat transfer and heat exchangers in fluid, operate air compressors, apply the knowledge of the flow of fluids, apply the knowledge of viscous flow of fluids, apply dimensional and models analysis fluids and operate fluid pumps.

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | To Apply Thermodynamic Processes | 14 |
|  | To Apply knowledge of perfect gases | 14 |
|  | To Apply knowledge of steam cycle | 14 |
|  | To Apply knowledge of fuel combustion | 14 |
|  | To Apply heat transfer and heat exchangers in fluid | 14 |
|  | To Operate air compressors | 14 |
|  | To Apply the knowledge of the flow of fluids | 14 |
|  | To Apply the knowledge of viscous flow of fluids | 14 |
|  | To Apply dimensional and models analysis fluids | 14 |
|  | To Operate fluid pumps | 14 |
|  | | 140 |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply Thermodynamic Processes | * 1. Basic thermodynamics terms definition      1. work,      2. Power      3. Internal Energy      4. Heat      5. Temperature   2. Laws of Thermodynamics      1. First law of thermodynamics      2. Second law of thermodynamics      3. Zeroth law of thermodynamics   3. Thermodynamic Processes      1. Non-flow Process.      2. Constant Volume Process      3. Constant Pressure Process      4. Hyperbolic Process.      5. Constant Temperature Process      6. Adiabatic Process      7. Polytropic Process.   4. Thermodynamics systems      1. Boundary and surrounding      2. Closed systems      3. Open systems      4. Isolated systems      5. Adiabatic system      6. Homogeneous systems      7. Heterogeneous systems   5. Heating and expansions of gases      1. Determine work done      2. Application of First Law of Thermodynamics      3. Reversible non-flow processes.      4. Irreversible non-flow processes   6. General Laws for Expansion and Compression      1. Define the terms:         1. Expansion         2. compression      2. Apply PVn = Constant for various values of n      3. Curves of pressure against volume for various values of n (index)   7. Application of Steady Flow Energy Equation to:      1. boilers      2. condensers      3. nozzles      4. diffusers      5. compressors      6. turbines | * Written tests |
| 1. Apply knowledge of perfect gases | * 1. Laws of Perfect Gases      1. Boyle's Law      2. Charles' Law      3. Gay-Lussac Law      4. Joule's Law      5. Avogadro's Law   2. General Gas Equation      1. Derive and apply general gas equation PV=nRT   3. Characteristic Equation of Gas      1. Application in engineering calculations   4. Universal Gas Constant      1. Define universal gas constant      2. Apply universal gas constant equation in engineering calculation   5. Specific Heat      1. Constant Volume      2. Constant Pressure | * Written tests |
| 1. Apply knowledge of steam cycle | * 1. Steam cycles      1. Rankine         1. Schematic diagram of a steam engine or turbine plant.         2. Determine Rankine efficiency         3. T-S and h-s graphs         4. Modified Rankine Cycle         5. Work-done using Rankine equations         6. Efficiency of Modified Rankine Cycle         7. Theoretical loss of work per kg of steam due to incomplete expansion         8. Loss in Rankine efficiency due to restricted expansion of steam         9. Enthalpy- entropy chart      2. Carnot         1. Draw schematic diagrams of Carnot engine         2. Carnot Cycle with Steam as Working Substance         3. Performance Criteria for Carnot Cycle      3. Reheat         1. T-S diagram of reheat steam cycle         2. Determine work-done using reheat equations         3. Determine efficiency of reheat cycles      4. Regenerative         1. Ideal regenerative cycle diagram         2. Regenerative Cycle with Single Feed Water Heater         3. Regenerative cycle with single feed water heater diagram         4. Determine work-done by Regenerative cycle         5. Determine Regenerative cycle efficiency         6. Regenerative Cycle with Two Feed Water Heaters and its efficiency   2. Thermodynamics steam turbines      1. Characteristics of steam turbines      2. classification of Steam Turbines      3. Pressure and Velocity of Steam in an Impulse Turbine      4. Velocity Triangles for Moving Blade of an Impulse Turbine      5. Combined Velocity Triangle for Moving Blades      6. Power Produced by an Impulse Turbine | * Written tests |
| 1. Apply knowledge of fuel combustion | * 1. Elements and Compounds of fuel      1. Define of terms         1. Element         2. Compound         3. Atoms         4. Molecules         5. Atomic Mass         6. Molecular Mass      2. Element and symbols table sketches   2. Combustion Equations of Fuels and calculations      1. Balanced Combustion Equations of Solid Fuels      2. Write a balanced Combustion Equations of Gaseous Fuels   3. Conversion analysis of fuels      1. Theoretical or Minimum Volume of Air Required for Complete Combustion      2. Conversion of Volumetric Analysis into Mass Analysis or Gravimetric Analysis      3. Conversion of Mass Analysis into Volumetric Analysis   4. Mass of Carbon in Flue Gases      1. Calculation of mass of carbon, contained in 1 kg of flue or exhaust gases   5. Mass of Flue Gases per kg of Fuel Burnt      1. Calculate the mass of dry flue gases by comparing the mass of carbon present in the flue gases with the mass of carbon in the fuel.   6. Excess Air Supplied calculations      1. Mass of excess air supplied by the mass of unused oxygen, found in the flue gases.      2. Total mass of air supplied   7. Flue Gas Analysis by Ors at Apparatus      1. Components      2. Use of the apparatus      3. Operation      4. Diagram sketches | * Written tests |
| 1. Apply heat transfer and heat exchangers in fluid | * 1. Heat transfer media      1. Heat Transfer methods:         1. Conduction         2. Convection         3. Radiation      2. Newton's Law of Cooling   2. Derivation and application of Fourier's\* Law of Heat Conduction equation   3. Heat Transfer by Conduction   through   * + 1. Slab        1. Thermal Conductivity        2. Temperature Gradient     2. Composite Wall     3. Thick Cylinder     4. Thick Sphere   1. Overall Coefficient of Heat Transfer      1. Heat exchangers | * Written tests |
| 1. Operate air compressors | * 1. Classification of air compressors      1. According to working      2. According to action      3. According to number of stages   2. Single Stage Reciprocating Air Compressor      1. Work done by a Single Stage Reciprocating Air Compressor without Clearance Volume   3. Work done during      1. isothermal compression      2. polytropic compression (pv" = Constant)      3. Isentropic compression   4. Power Required to Drive a Single-stage Reciprocating Air Compressor      1. Calculations   5. Work-done by Reciprocating Air Compressor with Clearance Volume      1. Calculations      2. Determine Multistage Compression   6. Power Required to Drive a Two-stage Reciprocating Air Compressor   7. Minimum Work Required for a Two-stage Reciprocating Air Compressor | * Written tests |
| 1. Apply knowledge of flow of fluids | * 1. Types of Fluid Flow      1. Steady and unsteady flows      2. Uniform and non-uniform flows      3. Rotational and irrotational flows      4. Laminar and turbulent flows      5. Compressible and incompressible flows   2. Loss of Energy (or Head) in Pipes      1. Darcy-weisbach formula      2. Chezy’s formula for loss of head due to friction      3. Loss of head due to sudden enlargement      4. Loss of head due to sudden contraction      5. Loss of head due to obstruction in pipe      6. Loss of head at the entrance to pipe      7. Loss of head at the exit of a pipe      8. Loss of head due to bend in the pipe   3. Hydraulic Gradient and Total Energy Lines      1. Pipes in Series or Compound Pipes      2. Pipes in Parallel      3. Power Transmission through Pipes | * Written tests |
| 1. Apply knowledge of viscous flow of fluids | * 1. Flow of viscous flow      1. Flow of Viscous Fluid in Circular Pipes      2. Flow of Viscous Fluid through an Annulus      3. Flow of Viscous Fluid Between Two Parallel Plates         1. One plate moving and other at rest         2. Both plates at rest         3. Both plates moving in opposite directions      4. Kinetic energy correction and momentum      5. Power Absorbed in Viscous Flow      6. Viscous Resistance of Journal Bearings      7. Viscous Resistance of Foot-step      8. Viscous Resistance of Collar Bearing | * Written tests |
| 1. Apply dimensional and models analysis fluids | * 1. Definition of terms      1. Dimensional homogeneity      2. Methods of solving dimensional analysis         1. Rayleigh’s theorem         2. Buckingham π theorem   2. Dimensional analysis similitude      1. Geometric      2. Kinematic      3. Dynamic   3. Dimensionless Numbers      1. Reynold’s Number (Re)      2. Froude’s Number (Fe)      3. Euler’s Number (Eu)      4. Weber’s Number (We)      5. Mach’s Number (M)   4. Model test analysis and calculations      1. Classification of Models         1. Undistorted Models         2. Distorted Models         3. Scale Ratios for Distorted Models | * Written tests |
| 1. Operate fluid pumps | * 1. Principles of operation of:      1. Reciprocating pumps      2. Centrifugal pumps   2. Derivation of equations for a reciprocating pump      1. Coefficient of discharge      2. percentage slip      3. Work done      4. Acceleration head      5. Friction head      6. Pressure head in the cylinder   3. Application of reciprocating pumps equations to solve problems   4. Derivation of equations for a centrifugal pump      1. Effective head      2. Manometric head      3. efficiency      4. Mechanical efficiency      5. Discharge      6. Torque      7. Work done unit weight      8. Specific speed   5. Application of centrifugal pumps equations to solve problems | * Written tests |

**Suggested Delivery Methods**

* Group discussions
* Demonstration
* Online videos
* Power point presentation

**Recommended Resources for 30 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** | | | |
|  | Textbooks | * + - 1. Applied Thermodynamics For Engineering Technology (fifth edition) by T.D. Eastop and A. McConkey       2. Engineering Thermodynamics by R.K.Rajput       3. A Textbook Of Fluid Mechanics And Hydraulic Machines by R.K.Rajput       4. A Textbook Of Fluid Mechanics And Hydraulic Machines by R.K Bansal | 30 |  |
|  | 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** | | | |
| 1. | Lecture/Theory Room | Spacious room with seats for 25 trainees, approximately 60 sqm | 1 | 1:30 |
| **C** | **Materials and Supplies** | | | |
|  | Dust coat/ overall | Shields skin and regular clothes from sparks | 30 | 1:1 |
|  | Fire extinguishers | Protect against fire | 30 | 1:1 |
|  | First Aid kit | Fully equipped First Aid kit for use in case of accidents | 1 | 1:30 |

# **CORE UNIT OF LEARNING**

# **VEHICLE COMFORT SYSTEM MAINTENANCE**

**UNIT CODE: 0716 551 23A**

**UNIT DURATION: 200** Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency service motor vehicle electrical systems

**Unit Description**

This unit specifies the competencies required to maintain vehicle comfort system. It includes to Service vehicle Heating, ventilation and Air conditioning system, Servicing vehicle infotainment system and carrying out vehicle Comfort system diagnosis

**Summary of Learning Outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcomes** | **Duration (Hours)** |
|  | Service vehicle Heating, ventilation and Air conditioning system | 70 |
|  | Service Vehicle infotainment system | 60 |
|  | Carry out Vehicle Comfort system diagnosis | 70 |
| **TOTAL** | | 200 |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Service vehicle Heating, ventilation and Air conditioning system | * 1. Workplace organisation and safety measures   2. Construction and operation   1.2.1 Heating and ventilation  1.2.2 Air condition system   * 1. Tools equipment and materials   2. Heating and ventilation components   1.4.1 Heat matrix   * + 1. Vents     2. Blowers   1.4.4 Air ducts   * + 1. Water hoses     2. Air filters     3. Heat exchanger etc   1.5 Air conditioning system  1.5.1 Evaporator  1.5.2 Heater blower motor  1.5.3 Condenser  1.5.4 Pump  1.5.5 Drier   * + 1. Piping etc   1. AC parts repair and testing   1.6.1 Gas refilling   * 1. Vehicle heating, ventilation and air conditioning components service/replacement      1. Electric and mechanical control of vehicle air conditioning system      2. Diagnosing of air conditioning system   2. Service documentation | * Written tests * Practical * Project * Portfolio of evidence * Third party report |
| 1. Service Vehicle infotainment system | * 1. Workplace organisation and safety measures   2. infotainment system layout   3. Infotainment installation tools and equipment   4. infotainment installation      1. Audio player      2. Camera system      3. Gesture controls      4. Voice Recognition      5. Navigation      6. Smart phone integration      7. Television   5. Components service/replacement   6. Service documentation | * Practical * Project * Portfolio of evidence * Third party report * Written tests |
| 1. Carry out Vehicle Comfort system diagnosis | * 1. Diagnosis Tools and equipment   2. Operation of on-board diagnostic kit      1. Diagnostics trouble codes      2. Trouble code interpretation   3. Sensors, actuators and circuits tests   4. Faulty sensors, actuators and circuits replacement/installation   5. Comfort system diagnosis 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. | 10 pcs | 1:2.5 |
| 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 | 10 | 1:2.5 |
|  |  |  |  |  |
| **C** | **Consumable Materials** | | | |
|  | First aid kit |  | 5 pieces | 1:5 |
|  | Insulating tape | For repairing components |  |  |
|  | Soldering wire | For repairing components |  |  |
|  | Paraffin | For cleaning components during services | 10 litres | 1:2.5 |
|  | Cable ties |  |  |  |
|  | Switches | For replacing during service | 5 pcs | 1:5 |
|  | Cotton waste | For cleaning components | 1 bag | 1:25 |
|  |  |  |  |  |
| **D** | **Tools and Equipment** |  |  |  |
|  | Complete vehicle | For servicing electrical components | 1 | 1:25 |
|  | 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 | 1:12.5 |
| **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 | 1:2 |
|  |  |  |  |  |
| **F** | **Reference Materials** |  |  |  |
| 1 | vehicle manuals | Covering principles and practices in vehicle electrical system | 25 pcs | 1:1 |
| 3 | Technical Handbooks | On vehicle comfort system | 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 | 25pcs | 1:1 |

# INDUSTRIAL ATTACHMENT

TIME: 480 hours