

**REPUBLIC OF KENYA**

**COMPETENCY BASED MODULAR CURRICULUM**

**FOR**

**CONSTRUCTION PLANT TECHNOLOGY**

**KNQF LEVEL 5**

**ISCED PROGRAMME CODE: 0716 454A**

©2025

All rights reserved. No part of this Curriculum may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods without the prior written permission of …….., except in the case of brief quotations embodied in critical reviews and certain other non-commercial uses permitted by copyright law. For permission requests, write to the Council Secretary/CEO/Chief Principal at the address below:

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 Mechanical Engineering 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 Construction Plant Engineering 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 Construction Plant Engineering Sector acquire competencies to perform their work more efficiently and effectively.

TABLE OF CONTENTS

[FOREWORD iv](#_Toc197165294)

[PREFACE v](#_Toc197165295)

[ACKNOWLEDGMENT vi](#_Toc197165296)

[ABBREVIATIONS AND ACRONYMS viii](#_Toc197165297)

[KEY TO ISCED UNIT CODE ix](#_Toc197165298)

[COURSE OVERVIEW x](#_Toc197165299)

[**MODULE I** 1](#_Toc197165300)

[DIGITAL LITERACY 2](#_Toc197165301)

[TECHNICAL DRAWING 28](#_Toc197165302)

[CONSTRUCTION PLANT ENGINES MAINTENANCE 34](#_Toc197165303)

[**MODULE II** 48](#_Toc197165304)

[COMMUNICATION SKILLS 49](#_Toc197165305)

[APPLIED MATHEMATICS 53](#_Toc197165306)

[ELECTRICAL AND ELECTRONICS PRINCIPLES 59](#_Toc197165307)

[CONSTRUCTION PLANT HYDRAULIC SYSTEM MAINTENANCE 81](#_Toc197165308)

[**MODULE III** 95](#_Toc197165309)

[ENTREPRENEURIAL SKILLS 96](#_Toc197165310)

[CONSTRUCTION PLANT TRANSMISSION SYSTEM MAINTENANCE 101](#_Toc197165311)

[CONSTRUCTION PLANT BRAKE SYSTEM MAINTENANCE 117](#_Toc197165312)

[**MODULE IV** 128](#_Toc197165313)

[WORK ETHICS AND PRACTICES 129](#_Toc197165314)

[MECHANICAL SCIENCE 135](#_Toc197165315)

[CONSTRUCTION PLANT STEERING AND SUSPENSION SYSTEMS MAINTENANCE 141](#_Toc197165316)

ABBREVIATIONS AND ACRONYMS

TVET Technical and Vocational Education and Training

RAM Random Access Memory

DVD Digital Versatile Disk

HDMI High-Definition Multimedia Interface

DVI Digital Visual Interface

VGA Video Graphics Array

USB Universal Serial Bus

ISCED International Standard Classification of Education

IEEE Institute of Electrical and Electronics Engineers

PPE Personal Protective Equipment

PLC Programmable Logic Controller

PCB Printed Circuit Board

LCD Liquid Crystal Display

LED Light Emitting Diode

ADC Analog-to-Digital Converter

DAC Digital-to-Analog Converter

IC Integrated Circuit

TRIAC Triode for Alternating Current

MOSFET Metal-Oxide-Semiconductor Field-Effect Transistor

BJT Bipolar Junction Transistor

RC Resistor Capacitor

RL Resistor Inductor

DC Direct Current

EMF Electromotive Force

MMF Magnetomotive Force

EV Electric Vehicle

SOC State of Charge

DOD Depth of Discharge

AC Alternating Current

KVL Kirchhoff's Voltage Law

KCL Kirchoff's Current Law

CV Curriculum Vitae

KEY TO ISCED UNIT CODE



COURSE OVERVIEW

The Construction Plant Technician Level 5 curriculum consists of competencies that a person must achieve to enable him/her to service, maintain the construction plant in industry. It includes applying digital literacy, applying communication skills, applying work ethics and practices, applying entrepreneurial skills, applying workshop technology, applying technical drawings, applying electrical and electronics principles, applying mathematics, and applying mechanical science. It also includes; maintaining construction plant hydraulic system, maintaining construction plant engine, maintaining construction plant brake system, maintaining construction plant transmission system and maintaining construction plant steering and suspension systems,

The units of competency comprising Construction Plant Technician Certificate Level 5 qualifications include the following competencies:

|  |  |  |
| --- | --- | --- |
| **UNIT CODE** | **UNIT NAME** | **DURATION(Hours)** |
| **MODULE I** | | |
| 0611451 01A | Digital Literacy | 80 |
| 0715 451 02A | Apply Workshop Technology | 80 |
| 0732 441 03A | Apply Technical Drawing | 80 |
| 0716451 04A | Maintain Construction Plant Engines | 160 |
| **TOTAL** | | **400 HRS** |
| **MODULE II** | | |
| 0031441 05A | Communication Skills | 40 |
| 0541 441 06A | Apply Mathematics | 80 |
| 0713441 07A | Electrical and Electronics Principles | 80 |
| 0716451 08A | Maintain Construction Plant Hydraulic System | 160 |
| **TOTAL** | | **360 HRS** |
| **MODULE III** | | |
| 0413441 09A | Entrepreneurial Skills | 40 |
| 0716 451 10A | Maintain Construction Plant Transmission System | 160 |
| 0716 451 11A | Maintain Construction Plant Brake System | 150 |
|  | **TOTAL** | **350 HRS** |
| **MODULE IV** | | |
| 0417441 12A | Work Ethics and Practices | 40 |
| 0715 441 13A | Mechanical science | 80 |
| 0716 451 14A | Maintain Construction Plant Steering and Suspension Systems | 150 |
| **TOTAL** | | **340HRS** |
| **INDUSTRIAL ATTATCHMENT** | | **480 HRS** |
| **GRAND TOTAL** | | **1930 HRS** |

**Entry Requirements**

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

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

Or

1. Completion of KNQF level 4 certificate in construction plant
2. Equivalent qualification as determined by TVETA.

**Trainer Qualification**

A trainer for any of the units of competency in this course must:

1. Possession of at least level 6 qualification in Construction Plant Engineering or its equivalent in Construction Plant Engineering.
2. Licensed by TVETA.
3. Registered by Engineer Board of Kenya (E.B.K) or Kenya Engineering Technology Registration Board (KETRB).

**Industry Training**

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

**Assessment**

The course shall be assessed formatively and summatively:

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

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

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

**Certification**

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

The certificates will be issued by the Qualification Awarding Institution

# **MODULE I**

DIGITAL LITERACY

**ISCED UNIT CODE: 0611 451 01A**

**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 learning outcomes 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**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **Duration (Hours)** |
|  | Solve tasks using office suite | 5 |
|  | Manage data and information | 10 |
|  | Perform online communication and collaborations | 5 |
|  | Apply cybersecurity skills | 5 |
|  | Perform online jobs | 10 |
|  | Apply job entry techniques. | 5 |
| **Total** | | **40** |

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

| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
| --- | --- | --- |
| 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 presentations       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 * Written * Practical assessment * Portfolio of Evidence * Project * 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 |
| 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 * Written * Practical assessment * Portfolio of Evidence * Project * 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 * Written * Practical assessment * Portfolio of Evidence * Project * 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 * Written * Practical assessment * Portfolio of Evidence * Project * 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   + Written   + Practical assessment   + Portfolio of Evidence   + Project   + assessment |

**Suggested Methods Instruction**

* + Instructor-led facilitation using active learning strategies
  + Demonstration
  + Practical
  + 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 | 1:6 |
|  | PowerPoint Presentations | For trainer’s use, covering course content and practical applications |  |  |
|  | 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 |  |

****WORKSHOP TECHNOLOGY****

**UNIT CODE: 0715 441 05A**

**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, carryout metal joining processes. It also includes performing material preservation and Applying workshop organisation techniques house keeping

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **Duration (Hours)** |
|  | Apply workshop safety | 5 |
|  | Apply material science principles | 10 |
|  | Apply workshop tools and equipment | 10 |
|  | Carry out metal joining processes | 20 |
|  | Perform material preservation | 20 |
|  | Apply workshop organization techniques | 15 |
| **Total** | | **80** |

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** | |
| --- | --- | --- | --- |
| 1. Apply workshop safety | * 1. Workshop safety      1. Workshop safety definition      2. Types and uses of PPE’s   2. Emergency responses steps      1. Common emergencies         1. Fire         2. Chemical spills         3. Injuries   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      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 prevention      1. Near Accident      2. Trivial Accident      3. Minor Accident      4. Serious Accident      5. Fatal Accident: | * 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. Steel rule         3. Callipers         4. Micrometer gauge         5. Protractor         6. Spirit level         7. Dial indicator         8. 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. Carry out metal joining processes | * 1. Observation of safety      1. Safety gears      2. Machine operation manuals   2. Metal joining methods      1. Welding         1. Arc welding         2. Gas welding      2. Riveting      3. Fastening   3. Material preparation      1. Measuring      2. Marking out   4. Process of metal finishing      1. Grinding      2. Filing      3. Polishing | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |
| 1. Perform engineering material preservation | * 1. Material preservation      1. Definition of material preservation      2. Importance of material preservation      3. Storage techniques      4. Material preservation safety measures   2. Common preservation methods      1. Protective coatings      2. Chemical treatments      3. Controlled storage conditions      4. Proper handling techniques      5. 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. Apply workshop organisation techniques | * 1. Workshop layout      1. Types of workshop layout         1. Fixed layout         2. Process layout         3. Line layout         4. Operation layout         5. Combination/group layout      2. Safety signs      3. Emergency exits   2. Management inventory      1. Types of inventories      2. Record keeping      3. Job card preparation   3. Maintenance schedules      1. Goals of maintenance schedule         1. Reactive         2. Equipment failure         3. Maintenance backlog      2. Types of maintenance         1. Preventive maintenance         2. Corrective maintenance         3. Condition based maintenance         4. Predictive maintenance         5. Break down maintenance   4. Housekeeping      1. Definition      2. Importance of housekeeping   5. Housekeeping activities and their Importance      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   6. 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   7. Housekeeping materials      1. Cleaning cloths and rags      2. Cleaning agents and solvents      3. Lubricants      4. Gloves and PPE’s      5. Disposable bags and liners   8. 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
* Exercises
* 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 Manual Metal Arc Welding (MMAW) | 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 |  |  |
|  | 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 litres |  |
| Floor detergents | 10 litres |
| Hand detergents | 10 litres |
| **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 |
|  | Callipers | Quality steel callipers 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 |
|  | **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 |  |  |  |
|  | **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 |

TECHNICAL DRAWING

**UNIT CODE: 0732451/07A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply technical drawing

**Duration of Unit:** 80

**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**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **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. Maskin tape      3. Clips      4. Drawing board      5. Clutch pencils   3. Use and maintenance of drawing equipment | * Practical Tests * Written tests * Portfolio of evidence |
| * + - 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 * Portfolio of evidence |
| 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 * Portfolio of evidence |
| 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 * Portfolio of evidence |
| 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 * Portfolio of evidence |
| 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 * Portfolio of evidence |

**Suggested Methods of Delivery**

* Projects
* Demonstration
* Practice
* Discussions

**Recommended Resources for 30 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
|  | Textbooks | Comprehensive texts books on Technical Drawing | 30 pcs | 1:1 |
|  | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:30 |
|  | Working drawings | Working drawings giving a detailed overview of the task at hand |  |  |
|  | 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 |
| **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 | 1:30 |
| **C** | **Consumable Materials** |  |  |  |
|  | Drawing papers | A4, A3 and A2 size drawing papers for drafting of sketches and working drawings | 1 ream | 1:30 |
|  | 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 | 30 sets | 1:1 |
|  | Pencil Sharpener | For creating sharp pencil tips | 30 pcs | 1:1 |
|  | Drawing Tables | For drawing | 30 pcs | 1:1 |
| **E** | **Reference Materials** |  |  |  |
|  | Welding /blueprint /drawing Standards | Reference on industry standards (e.g., BS, ANSI, AWS etc.) | 5 pcs | 1:6 |
|  | Multimedia Learning Modules | Videos and tutorials | 30 pcs | 1:1 |

CONSTRUCTION PLANT ENGINES MAINTENANCE

**UNIT CODE:** 0716 451 11A

**UNIT DURATION:** 160Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Maintain Construction Plant Engines

**Unit Description**

This unit describes the competencies required to perform construction plant engine overhaul, service construction plant engine cooling system, service construction plant engine lubrication system, Service construction plant exhaust system and Service construction plant fuel system.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **Duration (Hours)** |
|  | Perform construction plant engine overhaul | 80 |
|  | Service construction plant engine cooling system | 30 |
|  | Service construction plant engine lubrication system | 20 |
|  | Service construction plant exhaust system | 10 |
|  | Service construction plant fuel system. | 20 |
| **Total** | | **160** |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * 1. Perform construction plant engine overhaul | * 1. Personal protective equipment (PPE)      1. Apron      2. Safety boots      3. Gloves      4. Goggles      5. Cartridges/nose mask      6. Helmet      7. Ear muffs   2. Safety precautions      1. Training      2. Ventilation      3. Machine isolation      4. Hazard identification      5. Tool safety      6. Chemical handling      7. Communication      8. Securing the earth moving machine   3. Preparation of the work area   4. Identify tools and equipment      1. Fully equipped toolbox with assorted spanners      2. Engine lifting equipment         1. Engine hoist      3. Measuring and inspection tools         1. Vernier callipers         2. Optical gauge         3. Dial gauge         4. Micrometre screw gauge         5. Straight edge         6. Feeler gauge         7. Valve spring compressor         8. Spring tension gauge         9. Vernier height gauge         10. Try square         11. Engine compression test kit      4. Vee block      5. Lapping stick      6. Lapping paste   5. Engine removal      1. Draining engine oil      2. Draining the engine coolant      3. Removing of the engine peripherals         1. Intake manifolds         2. Exhaust manifold         3. Wire harness         4. Coolant piping      4. Setting up the engine lifting equipment      5. Removing engine mountings      6. Disconnecting engine from the gear box         1. Removing the engine   6. Engine dismantling   7. Cleaning engine major components      1. Cylinder head      2. Engine block      3. Pistons      4. Crankshafts      5. Camshafts      6. Valves      7. Connecting rods   8. Inspection of engine components      1. Cylinder head      2. Engine block      3. Pistons      4. Crankshafts      5. Camshafts      6. Valves      7. Connecting rods      8. Valve springs   9. Engine component measurements and tests      1. Crankshaft         1. Main journal bearing area ovality measurement         2. Con bearing area ovality measurement      2. Engine block         1. Warpage test         2. Cylinders ovality test         3. Cylinder taper test      3. Piston         1. Taper test         2. Ovality      4. Valves         1. Straightness         2. Sealing ability      5. Valve spring         1. Length         2. Squareness         3. Tension      6. Cylinder head         1. Warpage test   10. Cylinder head servicing       1. Valve lapping       2. Cylinder refacing       3. Leakage test   11. Replacement of worn-out engine components       1. Piston rings       2. Cylinder head gasket       3. Valves       4. Valve springs       5. Bearings       6. Valve guide bearing       7. Engine oil seals          1. Crankshaft main seal          2. Valve seals          3. Top cover oil seal   12. Assembly of engine components   13. Engine timing   14. Tappet adjustment   15. Engine compression test   16. Fitting engine back to the earthmoving machine.   17. Fitting back engine peripherals       1. Exhaust manifold       2. Intake manifold       3. Piping       4. Wire harness   18. Topping up engine oil   19. Topping up engine coolant   20. Fitting back the battery   21. Running the engine       1. Engine performance test       2. Engine tune up       3. Dynamometer test | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| * 1. Service construction plant engine cooling system | * 1. Gathering of tools and equipment      1. Cooling system service kit         1. Radiator cap pressure testing kit         2. thermometer      2. Fully equipped tool box with assorted spanners   2. Introduction to cooling system      1. Identification of cooling systems         1. Water cooling system   3. Inspection and servicing of the cooling system      1. Inspection of cooling fans      2. Inspection of fan belts      3. Inspection of the radiator         1. Radiator pressure test         2. Radiator cap pressure testing         3. Radiator leakage test         4. Radiator fins and tubing checks   4. Thermostat test   5. Water pump inspection      1. Visual inspection         1. Leakage checks         2. Corrosion checks         3. Coolant stains checks      2. Pulley and belt         1. Belt condition         2. Pulley movement      3. Unusual noises listening         1. Grinding or whining sounds      4. Coolant flow checking   6. Inspection of the coolant horses   7. Replacement of worn-out cooling system parts   8. Refilling of the coolant   9. Documentation of the service      1. Job cards      2. Checklists      3. Files      4. Logbooks   10. House keeping       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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| * 1. Service construction plant engine lubrication system | * 1. Preparing work area   2. Tools selection      1. Grease guns      2. Oil can      3. Assorted spanners      4. Oil filter wrench      5. Oil filter cap wrench      6. Oil filter pliers      7. Oil drain pan      8. Funnel      9. Oil extractor pump      10. Oil filter cutter      11. Lubricating flushing kit      12. Oil analysis kit      13. Torque wrench   3. Selecting of Service kits      1. Seal kits      2. Filter kits      3. Hose repair kits      4. Lubricants kits      5. Pump repair kits      6. Pressure gauge kits   4. Draining engine oil   5. Identifying engine lubrication components      1. Oil sump      2. Oil pump      3. Oil filters      4. Lubrication ducts   6. Identifying engine lubrication faults      1. Oil leaks      2. Clogged oil filters      3. Low oil level      4. Malfunctioning oil pumps   7. Rectifying engine lubrication faults   8. Flushing engine lubrication system   9. Replenishing the engine oil   10. Testing the engine lubrication system   11. Documenting the lubrication system service.   12. Performing house keeping | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| 1. Service construction plant exhaust system | * 1. Work area preparation   2. Selecting of tools and equipment      1. Exhaust gas analyser kit      2. Exhaust back pressure gauge      3. Catalytic converter test kit      4. Exhaust pipe cutters      5. Tool box with assorted spanners      6. multimeter      7. Exhaust system service kit         1. Exhaust hoses         2. Mufflers         3. Heat shield         4. Insulation materials         5. Gasket and seals   3. Checking for the exhaust system faults      1. Exhaust leaks      2. Faulty catalytic converter      3. Damaged muffler      4. Faulty oxygen sensor      5. Exhaust system vibration   4. Testing catalytic converter/ particulate filter      1. Emission test      2. Exhaust gas analysis      3. Visual inspection of the particulate filter   5. Dismantling exhaust system   6. Repairing exhaust system faults      1. Exhaust leaks      2. Faulty catalytic converter      3. Damaged muffler      4. Faulty oxygen sensor      5. Exhaust system vibration   7. Reassembling exhaust system   8. Testing and checking oxygen sensors   9. Testing exhaust system   10. Documenting exhaust system service   11. House keeping | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| * 1. Service construction plant fuel system | * 1. Safety observation   2. Work area preparation   3. Selection of tools and equipment      1. Assorted spanners      2. Injector nozzles tester   4. Service kit selection      1. Fuel filters      2. Fuel hoses      3. Fuel pumps      4. Seal and gaskets      5. Fuel additives      6. Cleaning tools      7. Diagnostic tools      8. Service manual   5. Fuel induction components identification      1. Fuel tank      2. Fuel pump      3. Priming pump (lift pump)      4. Fuel filter      5. Injector nozzles   6. Fuel system induction system induction system components testing and service      1. Fuel tank         1. Leakage tests         2. Cleaning      2. Injectors pump         1. Phasing         2. Pressure test         3. Calibration      3. Injector nozzle         1. Spray pattern test   7. Fuel system component’s fault inspection      1. Fuel tank      2. Fuel pump      3. Priming pump (lift pump)      4. Fuel filter      5. Injector nozzles   8. Repairing fuel components faults   9. Documenting fuel system service   10. Performing house keeping | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |

**Suggested Methods of delivery**

* Practicals
* Projects
* Demonstration
* Group discussion
* Direct instruction
* Industrial Visits

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S/No. | Category/Item | Description/ Specifications | Quantity | Recommended Ratio  (Item: Trainee) |
| A | **Learning Materials** |  |  |  |
|  | Textbooks |  | 5 pcs | 1:5 |
|  | Projector | For trainer’s use | 1 | 1:25 |
|  | Installation manuals |  |  |  |
|  | Charts |  |  |  |
|  | PowerPoint presentations | For trainer’s use | 1 |  |
|  | learning models | For trainer’s use | 1 | 1:25 |
|  | Earth moving machine engines |  | 5 | 1:5 |
| B | **Learning Facilities & Infrastructure** |  |  |  |
|  | Lecture/theory room |  | 1 | 1:25 |
|  | Workshop |  | 1 | 1:25 |
|  | Workbenches |  | 5 | 1:5 |
| C | **Consumable materials** |  |  |  |
|  | Assorted sealant | silicone | 400grams | 16:1 |
|  | Assorted gaskets |  |  |  |
|  | Assorted oil seals |  |  |  |
|  | Engine oil |  | 20 litres | 4:5 |
|  | First aid kit |  | 1 | 1:25 |
|  | Cleaning detergents | Enough | 1 litre | 1: 25 |
|  | Cotton wool waste | Enough | 2 kilograms | 2:25 |
|  | Kerosene |  | 20 litres | 4:5 |
|  | Assorted Emery papers |  | 1 roll | 1:25 |
| D | **Tools and Equipment** |  |  |  |
|  | Assorted spanners |  | 2 | 2:25 |
|  | Filter wrench |  | 4 | 4:25 |
|  | Torque wrench |  | 4 | 4:25 |
|  | jaw puller |  | 2 | 2:25 |
|  | Seal installer |  | 4 | 4:25 |
|  | Injector nozzle pressure tester |  | 5 | 1:5 |
|  | Micro meter screw gauge |  | 10 | 2:5 |
|  | Vernier callipers |  | 10 | 2:5 |
|  | Try Square |  | 10 | 2:5 |
|  | Vernier height gauge |  | 10 | 2:5 |
|  | Vee block |  | 10 | 2:5 |
|  | Dial gauge |  | 10 | 2:5 |
|  | Optical gauge |  | 10 | 2:5 |
|  | Straight edge |  | 10 | 2:5 |
|  | Lapping stick |  | 10 | 2:5 |
|  | Oil cans |  | 5 | 1:5 |
|  | Multimeter |  | 5 | 1:5 |
|  | Torque wrench |  | 5 | 1:5 |
|  | Feeler gauge |  | 5 | 1:5 |
|  | Hammer |  | 5 | 1:5 |
|  | Valve spring compressor |  | 3 | 3:25 |
|  | Spring tension gauge |  | 3 | 3:25 |
|  | Radiator pressure testing kit |  | 2 | 2:25 |
|  | Engine dynamometer tester |  | 1 | 1:25 |
|  | Thermometer |  | 5 | 1:5 |
|  | Exhaust gas analyzer kit |  | 2 | 2:25 |
|  | Exhaust back pressure gauge |  | 2 | 2:25 |
|  | Catalytic converter test kit |  | 1 | 1:25 |
|  | Exhaust pipe cutters |  | 2 | 2:25 |
| E. | **Earth Moving machines** |  |  |  |
|  | Bulldozer |  | 1 | 1:25 |
|  | Excavators |  | 1 | 1:25 |
|  | Backhoe loader |  | 1 | 1:25 |
|  | Grader |  | 1 | 1:25 |

# **MODULE II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Unit Duration (Hours)** | **Credit** |
| 003144104A | Communication Skills | 40 | **4** |
| 0541 441 06A | Apply Mathematics | 80 | **15** |
| 071344109A | Electrical and Electronics Principles | 80 | **13** |
| 0716451 11 A | Maintain Construction Plant Hydraulic System | 160 | **16** |

COMMUNICATION SKILLS

**ISCED UNIT CODE:** **0031 441 02A**

**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**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **Duration (Hours)** |
|  | Apply communication channels. | 8 |
|  | Apply written communication skills. | 8 |
|  | Apply non-verbal communication skills. | 8 |
|  | Apply oral communication skills. | 8 |
|  | Apply group communication skills. | 8 |
| **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 |  |

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 |

ELECTRICAL AND ELECTRONICS PRINCIPLES

**UNIT CODE:** **0713 441 09A**

**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**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **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 | * 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. e.m.f and internal resistance of cells   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. | * 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
* Practice
* Field trips
* Discussions

**Recommended Resources for 30 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 | 1:6 |
| 2 | Charts | Visual aids covering electrical theories and safety protocols | 10 pcs | 1:3 |
| 3 | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:30 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
| 1 | Lecture/Theory Room | Equipped with projectors and seating for 25 trainees, ~60 sqm | 1 | 1:30 |
| 2 | Workshop | Hands-on training area with workbenches, tools, and safety equipment, ~80 sqm | 1 | 1:30 |
| 3 | Computer Laboratory | Equipped with testing setups for electrical experiments, ~50 sqm.  Equipped with computers installed with Circuit simulation software. | 30 | 1:1 |
|  |  |  |  |  |
| **C** | **Consumable Materials** |  |  |  |
| 1 | Electrical Wires | Assorted sizes and color-coded (e.g., 1.5mm², 2.5mm², 4mm²) | 6 rolls | 1:5 |
| 2 | Insulation Tapes | For securing connections and insulation, assorted colors | 30 pcs | 1:1 |
| 3 | Breadboard | For prototyping and testing circuits | 6 pcs | 1:5 |
| 4 | Sensors | Assorted types (temperature, pressure, proximity) | 10 pcs | 1:3 |
| 5 | Signal generators | For generating AC signals | 6pcs | 1:5 |
| 6 | Transducers | Assorted | 10 pcs | 1:3 |
| 7 | Electronic components | Resistors, transistors, capacitors, relays, transformers. Integrated IC, OPAM. | 100pcs | 4:3 |
|  |  |  |  |  |
| **D** | **Tools and Equipment** |  |  |  |
| 1 | Screwdrivers | Assorted sets for various applications | 2 sets | 1:15 |
| 2 | Side Cutters | For cutting wires and cables | 4 pcs | 1:7.5 |
| 3 | Pliers | For gripping and bending wires | 3 pcs | 1:10 |
| 4 | Stripping Knives | For stripping insulation from wires | 4 pcs | 1:7.5 |
| 5 | Computers | Equipped with electrical and electronics simulation software | 6 pcs | 1:5 |
| 6 | Multimeters | For measuring voltage, current, and resistance | 6 pcs | 1:5 |
| 7 | Clamp Meters | For measuring current flow in circuits | 6 pcs | 1:5 |
| 8 | Oscilloscope | For observing waveforms and signals | 1 | 1:30 |
| 9 | Voltmeter | For measuring voltage | 1 | 1:30 |
| 10 | Ammeter | For measuring current | 1 | 1:30 |
| 11 | Signal Generator | For generating electrical signals for testing | 1 | 1:30 |
| 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 | 6 | 1:5 |
| 15 | Cells and batteries | For learning | 6 | 1:5 |
|  |  |  |  |  |
| **E** | **PPE (Personal Protective Equipment)** |  |  |  |
| 1 | PPE Sets | Includes helmets, gloves, safety goggles, shoes, and harnesses | 30 sets | 1:1 |
| 2 | Safety Signs and Barriers | For simulating safety zones and hazards | 10 sets | 1:3 |
| 3 | Earthing Test Kits | For ground testing and demonstrating earthing procedures | 6 pcs | 1:5 |
| 4 | Electrical Test Benches | For hands-on testing of functionality and circuit design | 6 pcs | 1:5 |
|  |  |  |  |  |
| **F** | **Reference Materials** |  |  |  |
| 1 | Industrial Automation Manuals | Covering principles and practices in automation | 30 pcs | 1:1 |
| 2 | Electrical Standards | Reference on industry standards (e.g., IEEE Guidelines) | 6 pcs | 1:5 |
| 3 | Technical Handbooks | On motors, drives, and wiring systems | 30 pcs | 1:1 |
| 4 | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:30 |
| 5 | Multimedia Learning Modules | Digital licenses for videos and tutorials | 30 pcs | 1:1 |
| 6 | Practical Assessment Guides | Worksheets for practical assessments | 30 pcs | 1:1 |

CONSTRUCTION PLANT HYDRAULIC SYSTEM MAINTENANCE

**UNIT CODE**: 0716 451 10A

**UNIT DURATION:** 160Hours

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Maintain construction plant hydraulic system

**UNIT DESCRIPTION**

This unit describes the competencies required to service construction plant hydraulic valves, replace construction plant hydraulic filter, service construction plant fuel tank, service construction plant pump, service construction plant hydraulic cylinder.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **Duration (Hours)** |
|  | Service construction plant hydraulic valves | 45 |
|  | Replace construction plant hydraulic filter | 15 |
|  | Service construction plant fuel tank | 15 |
|  | Service construction plant hydraulic pump | 55 |
|  | Service construction plant hydraulic cylinder. | 30 |
| **Total** | | **160** |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Service construction plant hydraulic valves | * 1. Safety observation      1. Personal protective equipment (PPE)      2. Apron      3. Safety boots      4. Gloves      5. Goggles      6. Cartridges/ nose mask      7. Helmet      8. Ear muffs   2. Safety precautions      1. Training      2. Ventilation      3. Machine isolation      4. Machine stabilization      5. Hazard identification      6. Tool safety      7. Chemical handling      8. Communication   3. Identification of hydraulic valves components      1. valve body      2. Spool      3. Solenoid      4. Springs      5. Seals      6. Ports      7. Actuators      8. Mounting brackets   4. Selection of tools      1. Hydraulic valves faults diagnosis      2. Application of Diagnostic kits      3. Hydraulic diagnostic kits      4. Electrical diagnostics kits      5. Engine diagnostics kits   5. Hydraulic valves service kit selection      1. Seal kits      2. Filter kits      3. Hose repair kits      4. Valve repair kits      5. Pump repair kits      6. Cylinder repair kits      7. Pressure gauge kits      8. Hydraulic fluid kits      9. Hydraulic tool kits   6. Hydraulic system dismantling   7. Cleaning and inspection of hydraulic system components      1. valve body      2. Spool      3. Solenoid      4. Springs      5. Seals      6. Ports      7. Actuators      8. Mounting brackets   8. Replacement of Damaged hydraulic valve components      1. Worn out parts      2. Broken parts      3. Rusted parts      4. Weak springs   9. Testing hydraulic valves      1. Leakage test      2. Pressure drop test      3. Operation or functional test      4. Crack pressure test      5. Response time test      6. Contamination test      7. Temperature test   10. Service documentation       1. Job cards       2. Checklists       3. Files       4. Logbooks   11. Housekeeping       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 |  |
| * Practical * Written test * Project * Third party report * Portfolio of evidence |
| 1. Replace construction plant hydraulic filter | * 1. Identification of hydraulic filters      1. Suction filter      2. Pressure filter      3. Return filter      4. Inline filter      5. Duplex filter      6. Magnetic filter      7. Hydraulic oil filter      8. Spin-on filter      9. Cartridge filter   2. Selection of hydraulic filters Service kits      1. O-rings      2. Seals      3. Fuel      4. Compressed air   3. Removal of the hydraulic filters      1. Suction filter      2. Pressure filter      3. Return filter      4. Inline filter      5. Duplex filter      6. Magnetic filter      7. Hydraulic oil filter      8. Spin-on filter      9. Cartridge filter   4. Cleaning and inspection of the hydraulic filters   5. Replacement of faulty hydraulic filters components      1. Clogged hydraulic filters      2. Worn out seals and O-rings   6. Installation of hydraulic filters   7. Service documentation      1. Job cards      2. Checklists      3. Files      4. Logbooks   8. Housekeeping      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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| 1. Service construction plant fuel tank. | * 1. Work area preparation   2. Locating fuel tank   3. Types of hydraulic fuel tank      1. Steel tanks      2. Aluminum tanks      3. Polyethylene tanks      4. Integrated fuel tanks      5. Customized      6. Pressurized hydraulic tanks      7. Auxiliary or external fuel tanks   4. Functions of hydraulic fuel tanks      1. Fuel storage      2. Fuel supply to engine      3. Ventilation and pressure management      4. Contaminant separation      5. Heat dissipation      6. Support for fuel gauging      7. Safety and spill and prevention      8. Fuel sedimentation collection   5. Tools selection      1. Fuel transfer pump      2. Fuel transfer hoses      3. Drip trays      4. Fuel storage container      5. Degreasers and cleaning solvents      6. Scrub brushes or wire brushes      7. Fuel quality tester      8. Borescope flashing or inspection light   6. Selecting service kits      1. Tank filter      2. Seals      3. Gaskets   7. Inspecting fuel tank      1. Leakages test      2. Cracks identification      3. Sediments check   8. Performing housekeeping      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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| 1. Service construction plant hydraulic pump | * 1. Preparing work area   2. Selecting service kits      1. Seals      2. O-ring      3. Bearings      4. Bushings      5. Valves      6. Springs      7. Hydraulic shafts and couplings      8. Hydraulic pump piston      9. Hydraulic pump rotors and vanes      10. Gaskets      11. Seal carrier      12. Adjustment kit.   3. Detaching of Hydraulic pump drive belt   4. Inspecting hydraulic pump drive belt   5. Identification of hydraulic fuel pumps.      1. Gear pump      2. Vane pump      3. Piston pump      4. Screw pump      5. Axial piston pump      6. Radial piston pump      7. Hand pump      8. Electric hydraulic pump      9. Hydraulic gear motor      10. Pressure compensator Gear pump      11. Vane pump      12. Piston pump      13. Screw pump      14. Axial piston pump      15. Radial piston pump      16. Hand pump      17. Electric hydraulic pump   6. Dismantling of hydraulic pump components.   7. Inspecting hydraulic pump components.      1. Pump housing      2. Pump drive shaft      3. Rotor and vanes      4. Pistons      5. Swash plate      6. Gears      7. Valves      8. Seals and gaskets      9. Inlet and outlet ports      10. Bearings      11. Wear plates      12. Coupling      13. Hydraulic gear motor      14. Pressure compensator   8. Replacing of Hydraulic pump components   9. Testing of Hydraulic pump components   10. Replacing of hydraulic pump drive belt   11. Service documentation       1. Job cards       2. Checklists       3. Files       4. Logbooks   12. Performing housekeeping       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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| 1. Service construction plant hydraulic cylinder. | * 1. Preparing work area   2. Selecting service kits      1. Hydraulic diagnostic      2. Seal      3. Wear ring      4. Rod end      5. Piston      6. Glad      7. Backup ring      8. O-ring      9. Rod wiper      10. Fastener      11. Lubrication and anti-corrosion      12. Bleed valve   3. Tools identification      1. Cylinder disassembly and assembly tools      2. Seal installation and removal      3. Hydraulic pressure gauge      4. Torque wrench      5. Cleaning and inspection tools      6. Bench vice      7. Cylinder hone   4. Draining of hydraulic oil   5. Disassembling of hydraulic cylinder components      1. Double-acting cylinder      2. Single-acting cylinder      3. Telescopic cylinder      4. Rodless cylinder      5. Pneumatic cylinder      6. Miniature cylinder      7. High-pressure cylinder      8. Hydraulic lift cylinder      9. Welded cylinder      10. Tie-rod cylinder   6. Inspecting of hydraulic cylinder   7. Disassembling of hydraulic cylinder   8. Reassembling of hydraulic cylinder   9. Testing of the hydraulic cylinder      1. Leak test      2. Pressure test      3. Drift test      4. Rod straightness test      5. Speed test      6. Load test      7. Endurance test | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |

**Suggested Methods of Delivery**

* Practical
* Project
* Demonstration
* Group discussion
* Direct instruction

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

* + Costruction plant industrial visits

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  (Item: Trainee) |
| **A** | **Learning Materials** |  |  |  |
|  | Textbooks |  | 5 pcs | 1:5 |
|  | Projector | For trainer’s use | 1 | 1:25 |
|  | Installation manuals |  |  |  |
|  | Charts |  |  |  |
|  | PowerPoint presentations | For trainer’s use | 1 |  |
|  | Learning models | For trainer’s use | 1 | 1:25 |
| **B** | **Learning Facilities & infrastructure** |  |  |  |
|  | Lecture/theory room |  | 1 | 1:25 |
|  | Workshop |  | 1 | 1:25 |
|  | Work benches |  | 5 | 1:5 |
| **C** | **Consumable materials** |  |  |  |
|  | Assorted Sealants |  | 5 rolls | 1:5 |
|  | Assorted gaskets |  | Enough  Enough |  |
|  | Assorted oil seals |  |  |  |
|  | hydraulic oil |  | 20 litres | 4:5 |
|  | First aid kit |  | 1 | 1:25 |
|  | Cleaning detergents |  | 1 litre | 1: 25 |
|  | Cotton wool waste |  | 2 kilograms | 2:25 |
|  | Kerosene |  | 20 litres | 4:5 |
|  | Grease |  | 5 kilograms | 5:25 |
|  | Lubricating oil |  | 20 litres | 4:5 |
|  | Assorted Emery papers |  | 1 roll | 1:25 |
| **D** | **Tools and Equipment** |  |  |  |
|  | Assorted fully equipped tool box |  | 2 | 2:25 |
|  | Filter wrench |  | 5 | 1:5 |
|  | Hydraulic pressure gauge |  | 1 | 1:25 |
|  | Oil analysis kit |  | 2 | 2:25 |
|  | Torque wrench |  | 5 | 1:5 |
|  | Hydraulic puller |  | 2 | 2:25 |
|  | Fluid transfer pump |  | 1 | 1:25 |
|  | Hydraulic cylinder repair kit |  | 4 | 4:25 |
|  | Seal installer |  | 4 | 4:25 |
| **E.** | **Earth Moving machines** |  |  |  |
|  | Bulldozer |  | 1 | 1:25 |
|  | Excavators |  | 1 | 1:25 |
|  | Backhoe loader |  | 1 | 1:25 |
|  | Cranes |  | 1 | 1:25 |
|  | Loader |  | 1 | 1:25 |
|  | Grader |  | 1 | 1:25 |
|  | Concrete mixer |  | 1 | 1:25 |
|  | Trencher |  | 1 | 1:25 |
|  | Paver |  | 1 | 1:25 |
|  | Hydraulic breaker |  | 1 | 1:25 |
|  | Backhoe loader |  | 1 | 1:25 |

# **MODULE III**

ENTREPRENEURIAL SKILLS

**ISCED UNIT CODE: 0413 441 04A**

**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**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **Duration (Hours)** |
|  | Apply financial literacy | 5 |
|  | Apply the entrepreneurial concept | 5 |
|  | Identify entrepreneurship opportunities | 5 |
|  | Apply business legal aspects | 5 |
|  | Innovate Business Strategies | 10 |
|  | Develop business plan | 10 |
| **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 * 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 * 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 * 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 * 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 * 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 * 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 |  |  |
|  | 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 |  |

CONSTRUCTION PLANT TRANSMISSION SYSTEM MAINTENANCE

**UNIT CODE:** 0716 451 13 A

**UNIT DURATION: 160 Hours**

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Maintain construction plant transmission system

**Unit Description**

This unit describes the competencies required to troubleshoot construction plant transmission system, sservice construction plant clutch assembly, and service construction plant hydrostatic transmission system, construct on plant hydrokinetic transmission system, Service construction plant final drive and service construction plant hydraulic motor

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **Duration (Hours)** |
|  | Troubleshoot construction plant transmission systems | 50 |
|  | Service construction plant clutch assembly | 20 |
|  | Service construction plant hydrostatic transmission system | 30 |
|  | Service construction plant final drive | 30 |
|  | Service construction plant hydraulic motor | 30 |
| **Total** | | **160** |

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

|  |  |  |
| --- | --- | --- |
| Learning Outcome | Content | Suggested Assessment Methods |
| * + 1. Troubleshoot construction plant transmission system | * 1. Personal protective equipment (PPE)      1. Apron      2. Safety boots      3. Gloves      4. Goggles      5. Cartridges/ nose mask      6. Helmet      7. Ear muffs   2. Safety precautions      1. Training      2. Ventilation      3. Machine isolation      4. Machine stabilization      5. Hazard identification      6. Tool safety      7. Chemical handling      8. Communication   3. Selecting Service Kits      1. Hydraulic Filters      2. Seals and O-Rings      3. Gaskets:      4. Hydraulic Fluid      5. Check and Relief Valves      6. Pump Rebuild Kits   4. Selecting tools and equipment      1. Pressure Gauges      2. Flow Meters      3. Leak Detection Tools      4. Torque Wrenches      5. Cleaning Kits      6. Dial Indicators      7. Service Laptop with Diagnostic Software      8. Cleaning Kits   5. Dismasting transmission components      1. Gearbox      2. Clutch assembly      3. Drive shafts      4. Torque converter      5. Differential      6. Transmission fluid      7. Synchronizers      8. Shift linkage      9. Transmission housing      10. Bearings   6. Inspecting transmission system components      1. Check for Leaks      2. Inspect Hoses and Fittings      3. Examine Seals and O-Rings      4. Reservoir Inspection   7. Diagnosing transmission system faults      1. Leakages      2. Cracks      3. Worn parts      4. Hard shifting   8. Testing hydraulic transmission system      1. Pressure test      2. Flow testing      3. Temperature testing      4. Leak detection      5. Component testing      6. Hydraulic and control system testing      7. System run down test   9. Service documentation      1. Job cards      2. Checklists      3. Files      4. Logbooks   10. Housekeeping       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 |  |
| * Practical assessment * Project * Third party report * Written test   Portfolio of evidence |
| * + 1. Service construction plant clutch assembly | * 1. Preparing work area      1. Safety Precautions      2. Organize Tools and Equipment      3. Prepare for Cleanliness      4. Organize Parts and Components      5. Prepare the Vehicle      6. Review Service Manual and Instructions      7. Lighting and Visibility   2. Identify clutch assembly components      1. Clutch disc      2. Pressure plate      3. Flywheel      4. Clutch release bearing      5. Clutch fork      6. Clutch master cylinder      7. Clutch slave cylinder      8. Clutch cable      9. Diaphragm spring      10. Pilot bearing   3. Selecting tools and equipment      1. Bleeder Kit      2. Brake and Clutch Fluid      3. Fluid Catch Bottle      4. Socket and Wrench Set      5. Brake Cleaner      6. Clutch Pedal Depressor Tool      7. Pliers and Screwdrivers      8. Hydraulic Jack and Jack Stands      9. Replacement Seals and Gaskets   4. Disassembling of construction plant clutch assembly   5. Inspecting of clutch components      1. Friction Material      2. Disc Thickness      3. Hub Splines      4. Surface Condition      5. Excessive Play      6. Alignment and Fit      7. Cracks or Bends      8. Hydraulic Lines      9. Fluid Quality:   6. Service clutch components assembly      1. Fluid Inspection and Replacement      2. Clutch Master Cylinder Service      3. Slave Cylinder Service      4. Clutch Line Inspection and Replacement      5. Adjustment of Clutch Pedal      6. Release (Throw-Out) Bearing Service      7. Pilot Bearing or Bushing Replacement      8. Bleeding the Clutch Hydraulic System      9. Flywheel Inspection and Resurfacing   7. Testing of the clutch components      1. Checks for leaks      2. Inspect clutch pedal      3. Master cylinder pressure test      4. Slave cylinder pressure test      5. Clutch pedal force test      6. Cutch pedal travel test      7. Engagement test      8. Disengagement test      9. Flow meter testing   8. Service documentation      1. Job cards      2. Checklists      3. Files      4. Logbooks   9. Housekeeping      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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| * + 1. Service construction plant hydrostatic transmission system | * 1. Preparing work area      1. Safety Precautions      2. Organize Tools and Equipment      3. Prepare for Cleanliness      4. Organize Parts and Components      5. Prepare the Vehicle      6. Review Service Manual and Instructions      7. Lighting and Visibility   2. Identify hydrostatic transmission components      1. Hydraulic Pump      2. Hydraulic Motor      3. Reservoir      4. Control Valve      5. Charge Pump      6. Relief Valve      7. Filter      8. Heat Exchanger      9. Hoses and Tubing   3. Selecting of tools and equipment      1. Pressure Gauge Kit      2. Flow Meter      3. Hydraulic Test Ports and Fittings      4. Dial Indicator      5. Torque Wrench      6. Hydraulic Fluid Filter Wrench      7. Oil Sample Kit   4. Dismantling hydrostatic transmission system   5. Inspecting of hydrostatic transmission fittings      1. Checking the hydraulic pressure system      2. Inspecting of hydraulic drive motors      3. Replacing of hydraulic fluid      4. Performing adjustment and calibrations of hydrostatic clutch system to specifications   6. Testing of hydrostatic transmission system   7. Inspecting of clutch components      1. Friction Material      2. Disc Thickness      3. Hub Splines      4. Surface Condition      5. Excessive Play      6. Alignment and Fit      7. Cracks or Bends      8. Hydraulic Lines      9. Fluid Quality:   8. Service clutch components assembly      1. Fluid Inspection and Replacement      2. Clutch Master Cylinder Service      3. Slave Cylinder Service      4. Clutch Line Inspection and Replacement      5. Adjustment of Clutch Pedal      6. Release (Throw-Out) Bearing Service      7. Pilot Bearing or Bushing Replacement      8. Bleeding the Clutch Hydraulic System      9. Flywheel Inspection and Resurfacing   9. Service documentation      1. Job cards      2. Checklists      3. Files      4. Logbooks   10. Housekeeping       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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| * + 1. Service construction plant final drive | * 1. Preparing work area      1. Safety Precautions      2. Organize Tools and Equipment      3. Prepare for Cleanliness      4. Organize Parts and Components      5. Prepare the Vehicle      6. Review Service Manual and Instructions      7. Lighting and Visibility  1. Identify construction plant final drive components    * 1. Hydraulic Motor      2. Planetary Gearbox (or Gear Reduction Assembly)      3. Brake Assembly      4. Final Drive Housing (or Casing)      5. Output Shaft 2. Selection of tools and equipment 3. Hydraulic jack lifts 4. Torque wrenches 5. Cranes 6. Sealant and gasket removal tools 7. Pressure testing equipment 8. Bearing pullers 9. Alignment tools 10. Diagnostic tools 11. Dismantling of hydrostatic final drive 12. Identifying drive configuration of transmission  * Input stage * Planetary gears * Output stage  1. Inspecting final drive for faults    * 1. Excessive vibration or noise      2. Leaks of hydraulic fluids      3. Loos of power or reduced speed      4. Overheating of the final drive      5. Final drive lockup 2. Servicing/repairing of damage final drive components 3. Inspecting of clutch components    * 1. Friction Material      2. Disc Thickness      3. Hub Splines      4. Surface Condition      5. Excessive Play      6. Alignment and Fit      7. Cracks or Bends      8. Hydraulic Lines      9. Fluid Quality: 4. Service clutch components assembly    * 1. Fluid Inspection and Replacement      2. Clutch Master Cylinder Service      3. Slave Cylinder Service      4. Clutch Line Inspection and Replacement      5. Adjustment of Clutch Pedal      6. Release (Throw-Out) Bearing Service      7. Pilot Bearing or Bushing Replacement      8. Bleeding the Clutch Hydraulic System      9. Flywheel Inspection and Resurfacing    1. Service documentation       1. Job cards       2. Checklists       3. Files       4. Logbooks    2. Housekeeping       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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| * + 1. Service construction plant hydraulic motor | * 1. Preparing work area      1. Safety Precautions      2. Organize Tools and Equipment      3. Prepare for Cleanliness      4. Organize Parts and Components      5. Prepare the Vehicle      6. Review Service Manual and Instructions      7. Lighting and Visibility   2. Identification of hydraulic motor components      1. Rotor      2. Stator      3. Drive shaft      4. Valve plate      5. Bearings      6. Housing      7. Pistons      8. Swashplate      9. Port plate      10. Seals   3. Selecting tools and equipment      1. Hydraulic pressure gauge      2. Torque range      3. Hydraulic oil filtration equipment      4. Seal puller/seal installation tool      5. Micrometres and callipers      6. Hydraulic motor pulley puller      7. Bearing puller      8. Vibration analysis equipment   4. Dismantling of hydraulic motor   5. Cleaning of hydraulic motor components   6. Inspecting of hydraulic motor components for faults      1. Visual inspection      2. Operational checks      3. Pressure and flow testing      4. Hydraulic fluid inspection      5. Seal and gasket inspection      6. Shaft and bearing inspection      7. Alignment check      8. Torque testing   7. Servicing/Replacing faulty hydraulic motor components   8. Seal and bearing replacement   9. Cleaning and filtration   10. Reconditioning and rebuilding   11. Performance calibrations   12. Testing of hydraulic motor components       1. Test for run out       2. Test for shaft wear       3. Check for end play in bearing       4. Pressure testing on seals and gaskets       5. Hydraulic test       6. Pressure relief valve test       7. Fluid quality test   13. Service documentation       1. Job cards       2. Checklists       3. Files       4. Logbooks   14. Housekeeping       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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |

Suggested Methods of Instruction

* Practical
* Projects
* Demonstration
* Group discussion
* Direct instruction
* Industrial Visits

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S/No. | Category/Item | Description/ Specifications | Quantity | Recommended Ratio  (Item: Trainee) |
| A | Learning Materials |  |  |  |
|  | Textbooks |  | 5 pcs | 1:5 |
|  | Installation manuals |  |  |  |
|  | Projectors | For trainer’s use | 1 | 1:25 |
|  | Laptops | For trainer’s use | 1 | 1:25 |
|  | Charts |  |  |  |
|  | PowerPoint presentations | For trainer’s use |  |  |
| B | Learning Facilities & infrastructure |  |  |  |
|  | Lecture/theory room |  | 1 | 1:25 |
|  | Workshop |  | 1 | 1:25 |
|  | Work benches |  | 5 | 1:5 |
|  | Transmission Models | For trainer’s use | 1 | 1:25 |
| C | Consumable materials |  |  |  |
|  | Transmission fluids/oil | 20 litters |  | 4:5 |
|  | Transmission filters | 1 | 5 | 1:5 |
|  | Gaskets and seals | 5 pieces | 5 | 1:5 |
|  | Grease | 2kilograms | 5 | 2:5 |
|  | Transmission belts | 5 pieces | 5 | 1:5 |
|  | Clutches and friction materials | 1 piece | 5 | 1:5 |
|  | Transmission Coolant | 5 litters | 5 | 1:5 |
| D | Tools and Equipment |  |  |  |
|  | Earth moving machines |  | 1 | 1:25 |
|  | Transmission fluid pumps |  | 5 | 1:5 |
|  | Fluid exchange machine |  | 5 | 1:5 |
|  | Fluid extractor |  | 5 | 1:5 |
|  | Scan tools/diagnostic computers |  | 5 | 1:5 |
|  | Pressure testers |  | 5 pcs | 1:5 |
|  | Torque wrenches |  | 5 pcs | 1:5 |
|  | Pneumatic tools |  | 5 pcs | 1:5 |
|  | Hydraulic jacks | For machines | 5pcs | 1:5 |
|  | Transmission jacks |  | 2 | 2:25 |
|  | Cleaning equipment |  |  |  |
|  | Specialized repair tools |  | 5 | 1:5 |
|  | Assorted Measuring and calibration tools |  | 5 | 1:5 |
|  | Transmission flush and cooling system equipment |  | 1 | 1:25 |
|  | Safety equipment |  | 25 | 1:1 |

CONSTRUCTION PLANT BRAKE SYSTEM MAINTENANCE

**UNIT CODE:** 0716 451 12A

**UNIT DURATION: 150** Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Maintain Construction Plant Brake System

**Unit Description**

This unit describes the competencies required to inspect construction plant braking system, service construction plant band brakes, service construction plant disk and drum brake system, service construction plant anchor type brake system and service construction plant toggle brakes.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **Duration (Hours)** |
|  | Inspect construction plant braking system | 30 |
|  | Service construction plant band brakes | 30 |
|  | Service construction plant disk and drum brake system | 30 |
|  | service construction plant anchor type brake system | 30 |
|  | Service construction plant toggle brakes. | 30 |
| **Total** | | **150** |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Inspect construction plant braking system | * 1. Personal protective equipment (PPE)      1. Apron      2. Safety boots      3. Gloves      4. Goggles      5. Cartridges/ nose mask      6. Helmet      7. Ear muffs   2. Observing safety precautions      1. Training      2. Ventilation      3. Personal protective gear      4. Machine isolation      5. Machine stabilization      6. Hazard identification      7. Tool safety      8. Chemical handling   3. Introduction to construction plant braking system      1. Types of construction plant brakes         1. Hydraulic Wet Disc Brakes         2. Drum Brakes         3. Hydraulic Dry Disc Brakes         4. Air Brakes         5. Parking Brakes         6. Anti-Lock Braking Systems (ABS)   4. Checking construction plant brake components      1. Brake Pads and Shoes      2. Brake Discs and Drums      3. Master Cylinder      4. Brake Calipers      5. Brake Lines and Hoses      6. Parking Brake Mechanism      7. Brake Actuators      8. Brake Booster (Power Brake Unit)      9. ABS (Anti-Lock Braking System) Sensors      10. Brake Fluids and Lubricants | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| 1. Service construction plant band brakes | * 1. Identify construction plant band brakes      1. Winch Brakes on Cranes      2. Drum Winches on Excavators      3. Crawler Dozers      4. Mining and Quarry Equipment   2. Preparing work area      1. Safety Precautions      2. Organize Tools and Equipment      3. Prepare for Cleanliness      4. Organize Parts and Components      5. Prepare the Vehicle      6. Review Service Manual and Instructions      7. Lighting and Visibility   3. Selecting correct tools and materials      1. Basic Hand Tools      2. Brake Band Lining Tools      3. Calipers and Measuring Tools      4. Brake Band Adjustment Tools      5. Lifting and Support Equipment      6. Cleaning and Lubrication Supplies      7. Inspection and Testing Equipment   4. Dismantling construction brake band component   5. Cleaning internal components for brake bands   6. Inspecting brake band component for faults      1. **Check for Cracks or Fractures**      2. Examine for Deformation      3. Inspect for Corrosion      4. Inspect Brake Lining      5. Look for Signs of Glazing      6. Examine Rivets or Adhesive Bonding      7. Evaluate Drum Condition      8. Inspect Adjustment Mechanisms   7. Servicing and repair of damages in brake bands      1. Install New Lining      2. Remove Rust and Corrosion      3. Reshape or Adjust the Band if Needed      4. Replace Worn Springs and Tensioners      5. Lubricate Moving Part      6. Smooth Drum Surface      7. Reinstall the Brake Band      8. Reconnect Tensioners and Adjusters      9. Adjust Band Tension      10. Check Band Alignment   8. Testing of construction plant brake band      1. Functional Test      2. Load Test      3. Check for Uneven Contact   9. Service documentation      1. Job cards      2. Checklists      3. Files      4. Logbooks   10. Housekeeping       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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| 1. Service construction plant drum and disk brake system | * 1. Identify construction drum brake and disk brake system      1. Drum Brake Components         1. Brake Drum         2. Brake Shoes         3. Brake Lining         4. Wheel Cylinder         5. Return Springs         6. Adjuster Mechanism         7. Backing Plate      2. Disc Brake Components         1. Brake Rotor (Disc         2. Brake Caliper         3. Brake Pads         4. Brake Piston (s         5. Caliper Bracket         6. Brake Fluid Lines         7. Anti-Rattle Clips         8. ABS Sensor (if equipped)         9. Dust Boots and Seals   2. Dismantling of brake drum and disk brake system   3. Clean the drum and disk brake components   4. Inspecting of brake drum and disk for faults      1. Check for Grooves, Scoring, or Cracks      2. Measure Drum Diameter      3. Check Lining Thickness      4. Look for Glazing or Contamination      5. Check for Weak or Damaged Springs      6. Inspect Mounting Hardware      7. Check for Leaks      8. Check Piston Operation      9. Look for Wear Marks or Grooves      10. Check for Rust or Corrosion      11. Check for Free Movement   5. Serving/Replacing faulty disk and drum components      1. Remove Worn Brake Shoes      2. Install New Brake Shoes      3. Replace Brake Lining if Needed      4. Rebuild the Cylinder      5. Replace Return Spring      6. Resurface the Drum      7. Replace Seals and Dust Boots      8. Resurface the Rotor   6. Reassemble drum and disk components   7. Carry out brake bleeding   8. Testing disk and drum brake components   9. Service documentation      1. Job cards      2. Checklists      3. Files      4. Logbooks   10. Housekeeping       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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| 1. Service construction plant anchor type brake system | * 1. Identify construction plant anchor brake system components      1. Anchor plate      2. Brake shoe      3. Brake drum      4. Actuating lever      5. Springs      6. Pivot pin      7. Adjustment screw      8. Brake lining      9. Mounting bracket   2. Dismantle construction plant anchor brake system   3. Clean the internal anchor brake system components   4. Inspecting anchor type brakes components for faults      1. Check for Damage or Excessive Wear      2. Inspect for Cracks      3. Examine Brake Shoe Lining Thickness      4. Check for Uneven Wear      5. Check for Secure Mounting      6. Inspect Pin and Bushing Wear      7. Corrosion      8. Check for Wear and Surface Condition   5. Servicing anchor type brake components      1. Replace or Rebuild Brake Shoes      2. Adjust Shoe Position      3. Install New Anchor Pin and Bushing      4. Align and Secure the Anchor Pin      5. Install New Springs      6. Lubricate and Reinstall      7. Flush and Replace Brake Fluid      8. Adjust Brake Shoe Clearance   6. Reassemble anchor brake system components   7. Testing anchor type brake components   8. Service documentation      1. Job cards      2. Checklists      3. Files      4. Logbooks   9. Housekeeping      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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |
| 1. Service construction plant toggle brakes | * 1. Identify construction plant toggle brakes      1. Brake lever      2. Toggle mechanism      3. Brake shoes      4. Brake drum      5. Spring      6. Actuating rod      7. Pivot pin      8. Mounting bracket      9. Adjustment nut      10. Cable assembly   2. Select the require tools      1. Wrenches and Socket Sets      2. **Brake Spring Pliers**      3. Brake Shoe Adjustment Tools      4. **Hydraulic Jack**      5. Hydraulic Fluid Dispenser      6. Brake Pressure Tester      7. Torque Wrench   3. Dismantle construction plant toggle brake   4. Inspect the toggle brakes for faulty      1. **Toggle Link Wear**      2. Brake Pads and Shoes      3. Drums and Rotors      4. **Springs and Retainers**      5. Check Fluid Levels      6. Inspect Brake Lines and Hoses      7. Inspect Brake Lines and Hoses   5. Servicing faulty toggle brake components   6. Testing toggle brake component      1. Brake Pedal Feel      2. Brake Engagement      3. Parking Brake Check   7. Service documentation      1. Job cards      2. Checklists      3. Files      4. Logbooks   8. Housekeeping      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 | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |

**Suggested Methods of Delivery**

* Practical
* Projects
* Demonstration
* Group discussion
* Direct instructions

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  (Item: Trainee) |
| **A** | **Learning Materials** |  |  |  |
|  | Textbooks |  | 5 pcs | 1:5 |
|  | Installation manuals |  |  |  |
|  | Projectors | For trainer’s use | 1 | 1:25 |
|  | Laptops | For trainer’s use | 1 | 1:25 |
|  | Charts |  |  |  |
|  | PowerPoint presentations | For trainer’s use |  |  |
| **B** | **Learning Facilities & infrastructure** |  |  |  |
|  | Lecture/theory room |  | 1 | 1:25 |
|  | Workshop |  | 1 | 1:25 |
|  | Work benches |  | 5 | 1:5 |
|  | Undercarriage model | For trainer’s use | 1 | 1:25 |
| **C** | **Consumable materials** |  |  |  |
|  | Brake Pads and Linings | For machine use | 1 | 1:25 |
|  | **Brake Fluid** | For machine use | 2 | 2:25 |
|  | Lubricants and Grease | For machine use | 1 | 1:25 |
|  | **Brake Cleaner** | For machine use | 1 | 1:25 |
|  | Brake Hardware Kits | For machine use | 1 | 1:25 |
|  | Brake Dust Shields and Boots | For machine use | 1 | 1:25 |
|  | Sealing Washers and Gaskets | For machine use | 1 | 1:25 |
|  | Rotors and Brake Drums | For machine use | 1 | 1:25 |
| **D** | **Tools and Equipment** |  |  |  |
|  | Earth Moving machines |  | 1 | 1:25 |
|  | Assorted/Specialized tools |  | 5 | 1:5 |
|  | Welding equipment |  | 2 | 2:25 |
|  | Measuring tools |  | 5 | 1:5 |
|  | Lifting chains equipment |  | 2 | 2:25 |
|  | Service manual |  | 2 | 2:25 |
|  | Track press cylinder seal kits |  | 5 | 1:5 |

# **MODULE IV**

WORK ETHICS AND PRACTICES

**ISCED UNIT CODE:** **0417 441 03A**

**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**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **Duration (Hours)** |
|  | Apply self-management skills | 5 |
|  | Promote ethical practices and values | 5 |
|  | Promote Teamwork | 10 |
|  | Maintain professional and personal development | 10 |
|  | Apply Problem-solving skills | 5 |
|  | Promote Customer care. | 5 |
| **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 * 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 * 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 * 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 * 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 * 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 * 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 |  |  |
|  | 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 |  |

MECHANICAL SCIENCE

**UNIT CODE: 0715 441 08A**

**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**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **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 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** | | | |
|  | 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 |

CONSTRUCTION PLANT STEERING AND SUSPENSION SYSTEMS MAINTENANCE

**UNIT CODE: 0716 451 14A**

**UNIT DURATION: 150** Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Maintain construction plant steering and suspension systems.

**Unit Description**

This unit describes the competencies required to service construction plant hydraulic valves, replace construction plant hydraulic filter, service construction plant fuel tank, service construction plant pump, service construction plant hydraulic cylinder.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **Duration (Hours)** |
|  | Inspect construction plant steering and suspension systems. | 50 |
|  | Service construction plant steering system | 50 |
|  | Service construction plant suspension system | 50 |
| **Total** | | **150** |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Inspect construction plant steering and suspension systems. | * 1. Personal protective equipment (PPE)      1. Apron      2. Safety boots      3. Gloves      4. Goggles      5. Cartridges/ nose mask      6. Helmet      7. Ear muffs   2. Safety precautions      1. Training      2. Ventilation      3. Machine isolation      4. Machine stabilization      5. Hazard identification      6. Tool safety      7. Chemical handling      8. Communication   3. Selecting tools and equipment      1. Wrenches and ratchet      2. Impact wrench      3. Hammers      4. Pin punch sets      5. Bearing press      6. Service manual      7. Grease gun      8. Screw drivers      9. Pliers      10. Torque wrenches      11. Hydraulic pullers      12. Spring compressors   4. Inspecting steering system      1. Steering wheels      2. Steering column      3. Steering gearboxes      4. Tie rods      5. Pitman arm      6. Centre link/drag link      7. Steering pump      8. Steering fluid reservoirs      9. Steering shaft      10. Steeling coupler   5. Activity documenting      1. Job cards      2. Checklists      3. Files      4. Logbooks   6. Performing housekeeping      1. Waste disposal method      2. Recycling methods      3. Resource management      4. Pollution control      5. Cleaning | * Project * Third party report * Written test * Portfolio of evidence Practical assessment |
| Service construction plant steering system | * 1. Selecting tools and equipment      1. Wrenches and ratchet      2. Impact wrench      3. Hammers      4. Pin punch sets      5. Bearing press      6. Service manual      7. Grease gun      8. Screw drivers      9. Pliers      10. Torque wrenches      11. Hydraulic pullers      12. Spring compressors   2. Draining lubricant      1. Hydraulic fluid      2. Grease      3. Power steering fluid      4. Penetrating oil      5. Silicone based lubricant   3. Disassembling Steering components      1. Steering wheels      2. Steering column      3. Steering gearboxes      4. Tie rods      5. Pitman arm      6. Centre link/drag link      7. Steering pump      8. Steering fluid reservoirs      9. Steering shaft      10. Steering coupler   4. Inspecting Steering components      1. leaks      2. Breakages      3. Cracks      4. Rust      5. Play or looseness      6. Bends      7. dents   5. Testing steering components      1. Straightness      2. Wheel play      3. Hydraulic pressure      4. Steering gear and linkage      5. Tie rod ends      6. Steering assists      7. Powe steering test      8. Alignment test      9. Load test      10. Steering stop function   6. Servicing Steering components      1. Steering wheels      2. Steering column      3. Steering gearboxes      4. Tie rods      5. Pitman arm      6. Centre link/drag link      7. Steering pump      8. Steering fluid reservoirs      9. Steering shaft      10. Steeling coupler   7. Applying technical information      1. Service manual reference   8. Assembling steering system      1. Assembly of steering component   9. Application lubricant      1. Steering linkage joints      2. Steering box and gears      3. Kingpin and bushing      4. Swivel joint and pivot joints      5. Hydraulic connections      6. Steering system testing   10. Road test | * Project * Third party report * Written test * Portfolio of evidence Practical assessment |
| 1. Service construction plant suspension system | * 1. Selection tools and equipment      1. Spring compressor      2. Hydraulic jack and lift      3. Torque wrenches      4. Suspension alignment tools      5. Component puller      6. Shock absorber tester      7. Grease gun      8. Measuring tools         1. Micrometre         2. Callipers screw gauge      9. Bushing removal tool      10. Hydraulic press equipment      11. Assorted spanners   2. Inspection of suspension system      1. Steering linkages         1. Checking for any damage         2. Wear, cracks and ben ding         3. Misalignment      2. Steering cylinder         1. Leakage inspection         2. Damage inspection      3. Steering pump and fluid         1. Leakage checks      4. Steering wheel or control mechanism         1. Test for smooth operation      5. Tie rods and ball joints         1. Wear and damage checks      6. Operation test         1. Turning steering checks   3. Steering suspension system dismantling      1. Disconnect the Power Sources         1. Hydraulic Systems            1. Depressurizing the system            2. Disconnection of hydraulic hoses            3. Capping off any open hydraulic lines to prevent contamination.         2. Pneumatic Systems            1. Releasing air pressure from the system.            2. Disconnecting air lines         3. Electrical Systems            1. Disconnection of any electrical connections      2. Removal of Suspension Components         1. Removal of external attachments         2. Loosening and removal of fasteners         3. Disconnection of the Suspension Arms and Linkages         4. Removal of springs, shock absorbers, or dampers   4. suspension system components cleaning   5. Inspection of suspension system components      1. Visual inspection         1. Coil springs            1. Checking for deformation            2. Inspect for Surface damage   Spring Tension   * + - 1. Shock absorbers/dampers:          1. Looking for leaks          2. Checking for damage          3. Compression test       2. Suspension Arms          1. Inspection for cracks and deformation          2. Checking of for rust or corrosion       3. Linkages and mounting points          1. Checking of bolts and fasteners          2. Inspection of bearings and bushings   1. Replacement of faulty suspension system components   2. Assembling suspension system      1. Installation of suspension frame      2. Installation of suspension springs:      3. installation of shock absorbers      4. Installation of suspension arms and linkages      5. Installation of hydraulic/pneumatic components:      6. Installation of cables/chains/rods      7. Reconnection of systems      8. Alignment and clearance      9. Testing      10. Final inspection   3. Adjustment of steering system      1. Adjusting steering linkages      2. Aligning and tightening linkages.      3. Checking steering play      4. Adjusting steering gear for play      5. Hydraulic steering adjustment      6. Adjusting steering stops      7. Testing steering system   4. Performing road-tests      1. Initial visual inspection      2. Checking for fluid levels      3. Testing steering operation      4. Checking suspension functionality      5. low-speed test      6. High-speed test      7. Check for unusual noises      8. Testing turning and maneuvering      9. Load test (if applicable)      10. Final checks | * Practical assessment * Project * Third party report * Written test * Portfolio of evidence |

**Suggested Methods of Instruction**

* Practicals
* Projects
* Demonstration
* Group discussion
* Direct instruction
* Industrial Visits

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S/No. | Category/Item | Description/ Specifications | Quantity | Recommended Ratio  (Item: Trainee) |
| A | **Learning Materials** |  |  |  |
|  | Textbooks |  | 5 pcs | 1:5 |
|  | Projector | For trainer’s use | 1 | 1:25 |
|  | Installation manuals |  | 5 copies | 1:5 |
|  | Charts | For trainer’s use | 10 | 2:5 |
|  | PowerPoint presentations | For trainer’s use | 1 |  |
|  | learning models | For trainer’s use | 1 | 1:25 |
|  | Earth moving steering and suspension system | For trainer’s use | 2 | 2:25 |
| B | **Learning Facilities & infrastructure** |  |  |  |
|  | Lecture/theory room |  | 1 | 1:25 |
|  | Workshop |  | 1 | 1:25 |
|  | Work benches |  | 5 | 1:5 |
| C | **Consumable materials** |  |  |  |
|  | Assorted sealant | silicone | 400 grams | 16:1 |
|  | Assorted gaskets |  | 5 | 1:5 |
|  | Assorted oil seals |  | 5 | 1:5 |
|  | First aid kit |  | 1 | 1:25 |
|  | Kerosene |  | 20 litres | 4:5 |
|  | Assorted Emery papers |  | 1 roll | 1:25 |
|  | Hydraulic fluid |  | 30 litres | 6:5 |
|  | Power steering fluid |  | 20 litres | 4:5 |
|  | Grease |  | 10 kilograms | 2:5 |
|  | Assorted steering fluid filters |  | 5 litres | 1:5 |
|  | Assorted belt |  | 5 | 1:5 |
|  | Brake fluid |  | 10 litres | 2:5 |
|  | Assorted dust cover boots |  | 5 | 1:5 |
|  | Assorted bushings and bearings |  | 5 | 1:5 |
|  | Assorted replacement bolts and nuts |  | 5 | 1:5 |
|  | Shock absorber fluid |  | 20 litres | 4:5 |
|  | Suspension fluid |  | 20 litres | 4:5 |
|  | Assorted suspension bushings |  | 5 | 1:5 |
|  | Assorted O-rings |  | 5 | 1:5 |
|  | Assorted air suspension filters |  | 5 | 1:5 |
|  | Assorted Suspension fluid filters |  | 5 | 1:5 |
| D | **Tools and Equipment** |  |  |  |
|  | Hydraulic Pump Tester |  | 2 | 2:25 |
|  | Torque Wrench |  | 4 | 4:25 |
|  | Steering Alignment Tools |  | 4 | 4:25 |
|  | Power Steering Pump Puller |  | 2 | 2:25 |
|  | Electronic Diagnostic Scan Tool |  | 3 | 3:25 |
|  | Wheel Alignment Machine |  | 1 | 1:25 |
|  | Steering and Suspension Tester |  | 3 | 3:25 |
|  | Hydraulic Pressure Tester |  | 3 | 3:25 |
|  | Suspension Load Tester |  | 3 | 3:25 |
|  | Ball Joint Press |  | 1 | 1:25 |
|  | Tie Rod End Puller |  | 5 | 1:5 |
|  | Pitman Arm Puller |  | 3 | 3:25 |
|  | Steering Box Puller |  | 3 | 3:25 |
|  | Steering Gearbox Tester |  | 2 | 2:25 |
|  | Tie Rod Remover Tool |  | 3 | 3:25 |
|  | Suspension Spring Compressor |  | 5 | 1:5 |
|  | Shock Absorber Testing Equipment |  | 1 | 1:25 |
|  | Strut Spring Compressor |  | 3 | 3:25 |
|  | Ball Joint Separator |  | 3 | 3:25 |
|  | Suspension Bushings Tool |  | 2 | 2:25 |
|  | Suspension Alignment Tool |  | 1 | 1:25 |
|  | Hydraulic Jack |  | 5 | 5:25 |
|  | Hydraulic Press |  | 1 | 1:25 |
|  | Hydraulic Lifting Equipment |  | 1 | 1:25 |
|  | Impact Wrench |  | 1 | 1:25 |
|  | Torque Wrench |  | 2 | 2:25 |
|  | Pry Bars |  | 2 | 2:25 |
|  | Screwdrivers and Pliers |  | 2 sets | 2:25 |
|  | Suspension Vibration Analyzer |  | 1 | 1:25 |
|  | Suspension Bushings |  | 5 | 1:5 |
|  | Workbenches with Vices |  | 5 | 5:25 |
|  | Wheel and Tire Balancer |  | 2 | 2:25 |
| E. | **Earth Moving machines** |  |  |  |
|  | Bulldozer |  | 1 | 1:25 |
|  | Excavators |  | 1 | 1:25 |
|  | Backhoe loader |  | 1 | 1:25 |
|  | Grader |  | 1 | 1:25 |