REPUBLIC OF KENYA

COMPETENCY BASED MODULAR CURRICULUM

FOR

WELDING TECHNOLOGY

KNQF LEVEL 5

CYCLE 3

PROGRAMME ISCED CODE: 0715 454A

TVET CDACC
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FOREWORD

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

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

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

It is my conviction that this curriculum will play a great role in developing competent human resources for the Welding & Fabrication 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.

CHAIRMAN
TVET CDACC

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 Welding 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 Welding & Fabrication 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 Welding & Fabrication Sector acquire competencies to perform their work more efficiently and effectively.

COUNCIL SECRETARY/CEO

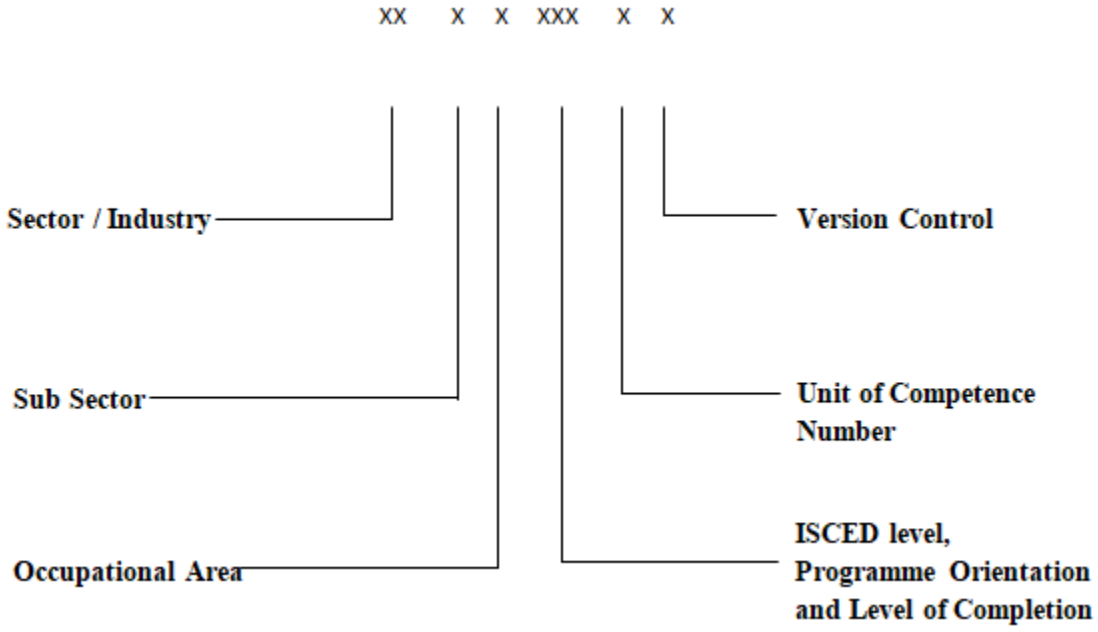
TVET CDACC

TABLE OF CONTENTS

ACRONYMS

AC	Alternating Current
CPU	Central Processing Unit
DC	Direct Current
DVI	Digital Visual Interface
FCAW	Flux Cored Arc Welding
GMAW	Gas Metal Arc Welding
HDMI	High-Definition Multimedia Interface
KCSE	Kenya Certificate of Secondary Education
KNQA	Kenya National Qualifications Authority
MAG	Metal Active Gas
MIG	Metal Inert Gas
MMAW	Manual Metal Arc Welding
NNP	Nyeri National Polytechnic
PPE	Personal Protective Equipment
RAM	Random Access Memory
TIG	Tungsten Inert Gas
TVETA	Technical and Vocational Education and Training Authority
USB	Universal Serial Bus
VGA	Video Graphics Array

KEY TO ISCED UNIT CODE



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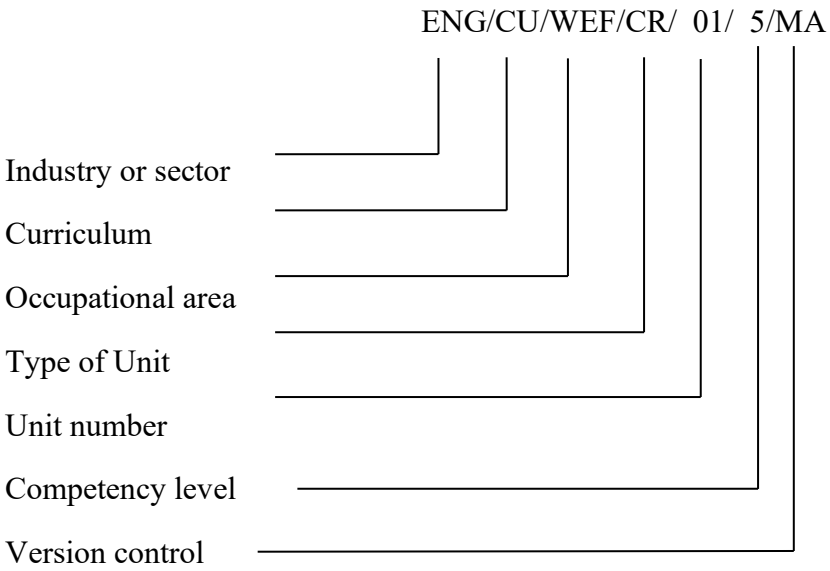

COURSE OVERVIEW

Welding Technology Level 5 qualification consists of competencies that an individual must achieve to enable him/her to work in a welding establishment as a Welding Technician. It involves fabrication processes, arc welding processes, gas welding, soldering and brazing processes, metal inert gas welding, tungsten inert gas welding, and gas metal arc welding operations.

SUMMARY OF UNITS OF LEARNING

ISCED Unit Code	TVET CDACC Unit Code	Unit Title	Unit Duration (Hours)	Credit Factor
MODULE I				
0715 251 01A	ENG/CU/WEF/CR/01/3/MA	Fabrication Processes I	150	15
0715 251 02A	ENG/CU/WEF/CR/02/3/MA	Arc Welding Processes I	100	10
0715 251 03A	ENG/CU/WEF/CR/03/3/MA	Gas welding, Soldering and Brazing Processes	100	10
MODULE II				
0715 351 04A	ENG/CU/WEF/CR/01/4/MA	Metal Inert Gas Welding	200	**20**
0715 351 05A	ENG/CU/WEF/CR/02/4/MA	Tungsten Inert Gas Welding	200	**20**
MODULE III				
0031 441 06A	ENG/CU/WEF/BC/02/5/MA	Communication Skills	40	**4**
0417 441 07A	ENG/CU/WEF/BC/03/5/MA	Work Ethics and Practices	40	**4**

0715 441 08A	ENG/CU/WEF/CC/01/5/MA	Metallurgy	120	**12**
0541 441 09A	ENG/CU/WEF/CC/02/5/MA	Mathematics	120	**12**
0715 451 10A	ENG/CU/WEF/CR/01/5/MA	Arc Welding Processes II	100	**10**
0715 451 11A	ENG/CU/WEF/CR/02/5/MA	Fabrication Processes II	100	**10**
MODULE IV				
0611 441 12A	ENG/CU/WEF/BC/01/5/MA	Digital Literacy	40	**4**
0413 441 13A	ENG/CU/WEF/BC/04/5/MA	Entrepreneurial Skills	40	**4**
0732 441 14A	ENG/CU/WEF/CC/03/5/MA	Apply Technical Drawings	100	**10**
0715 441 15A	ENG/CU/WEF/CC/04/5/MA	Mechanical Science	50	**5**
0713 441 16A	ENG/CU/WEF/CC/05/5/MA	Electical & Electronics Principles	120	**12**
0715 451 17A	ENG/CU/WEF/CR/03/5/MA	Gas Metal Arc Welding Operations	150	**15**
	ENG/CU/WEF/CR/04/5/MA	Industrial Attachment	480	48
		GRAND TOTAL	**2240**	**224**

Entry Requirements

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

a) Kenya Certificate of Secondary Education (KCSE) with a grade of D (Plain)

OR

b) Possession of a KNQF Level 4 qualification certificate in welding or any other related field.

Or

c) Equivalent qualification as determined by TVETA

Trainer qualification

Qualifications of a trainer for this course include:

a) Possession of at least level 6 Welding qualification or its equivalent in Welding & Fabrication; and
b) Licensed by TVETA
c) Registered by Engineer Board of Kenya (E.B.K) or Kenya Engineering Technology Registration Board (KETRB).

Credit Accumulation, Transfer, and Exemptions

TVET CDACC Guidelines on credit accumulation and transfer shall apply.

Industry Training

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

Assessment

The course shall be assessed formatively and summatively:

a) During formative assessment all performance criteria shall be assessed based on performance criteria weighting.
b) Number of formative assessments shall minimally be equal to the number of elements in a unit of competency.

c) During summative assessment basic and common units may be integrated in the core units or assessed as discrete units.

d) Theoretical and practical weighting for each unit of learning shall be as follows:

   i. 10:90 for the units in modules I and Module II; and

   ii. 30:70 for the units in modules III and IV.

e) Formative and summative assessments shall be weighted at 60% and 40% respectively in the overall unit of learning score

f) For a candidate to be declared competent in a unit of competency, the candidate must meet the following conditions:

   i) Obtained at least 40% in theory assessment in formative and summative assessments.

   ii) Obtained at least 60% in practical assessment in formative and summative assessment where applicable.

   iii) 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.

g) 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
X	Absent
CRNM	Course Requirement Not Met

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

Certification

A candidate will be awarded with a Certificate of Competency upon demonstration of competence in a core Unit of Competency. To be awarded Kenya National TVET Certificate in Welding Technology 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 awarded upon demonstration of competence in a certifiable element within a unit.

The certificates shall be awarded by TVET CDACC.

MODULE I

FABRICATION PROCESSES I

Unit Code: 0715 251 10A

TVET CDACC UNIT CODE: ENG/CU/WEF/CR/01/3/MA

Unit Duration: 150 Hours

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Perform Fabrication Processes I

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train fabrication processes I. The learning outcomes include carrying out bench work, sheet metal work, surface finishing operations and maintaining fabrication tools, machines and equipment.

Summary of Learning Outcomes

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

S/NO	Learning Outcomes	Duration (Hours)
1.	Carry out bench work	60
2.	Carry out sheet metal work	55
3.	Carry out surface finishing operations	25
4.	Maintain fabrication tools, machines and equipment	10
Totals		**150**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Carry out bench work	1.1 Occupational health and safety standards 1.1.1 Benchwork hazards identification 1.1.1.1 Physical	• Practical test • Project work • Written tests • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	1.1.1.2 Chemical 1.1.1.3 Biological 1.1.1.4 Psychological 1.1.2 Benchwork ergonomics 1.1.3 Workshop waste management 1.1.4 Workplace environmental safety 1.1.5 Benchwork safety 1.2 Emergency procedures in benchwork 1.3 Bench work tools and equipment 1.3.1 Types 1.3.2 Correct usage 1.3.3 Care and storage 1.4 Fabrication drawing interpretation 1.4.1 Dimensions 1.5 Material preparation in benchwork (metals up to 6 mm thickness) 1.5.1 Measuring 1.5.2 Marking out 1.5.3 Cutting 1.5.4 Edge preparation	

Learning Outcome	Content	Suggested Assessment Methods
	1.6 Benchwork operations (metals up to 6 mm thickness) 1.6.1 Types 1.6.1.1 Filing 1.6.1.2 Grinding 1.6.1.3 Drilling 1.6.1.4 Reaming and tapping. 1.6.1.5 Sawing and cutting 1.6.2 Procedure and applications 1.7 Fitting and assembly in benchwork (up to 6 mm thickness) 1.7.1 Types and applications of fasteners 1.7.1.1 Bolts 1.7.1.2 Screws 1.7.1.3 Nuts 1.7.1.4 Rivets **Practice** ❑ Filing of steel plates and pipes of up to 6 mm thickness ❑ Grinding of metal plates and pipes of up to 6 mm thickness	

Learning Outcome	Content	Suggested Assessment Methods
	❑ Drilling of metal plates up to 6 mm thickness ❑ Reaming and tapping of metal plates up to 6 mm thickness ❑ Cutting of metal plates and pipes up to 6 mm thickness	
2. Carry out sheet metal work	2.1 Occupational health and safety standards in sheet metals 2.2 Sheet metal hazards identification 2.2.1 Physical 2.2.2 Chemical 2.2.3 Biological 2.2.4 Psychological 2.3 Sheet metal workshop Incident/Accident reporting 2.4 Sheet metal work ergonomics 2.5 Sheet metal workshop waste management 2.6 Personal Protective Equipment used in sheet metal work 2.7 Sheet metal work procedures 2.8 Roles and responsibilities in sheet metal workshop 2.9 Emergency procedures in sheet metal work	• Practical test • Project work • Written tests • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	2.10 Housekeeping in sheet metal work 2.10.1 Cleaning 2.10.2 Waste management 2.11 Sheet metal work tools and equipment 2.11.1 Types 2.11.2 Correct usage 2.11.3 Care and storage 2.12 Material preparation in sheet metal work (up to 6 mm thickness) 2.12.1 Measuring 2.12.2 Marking out 2.12.3 Cutting 2.12.4 Edge preparation 2.13 Sheet metal work operations (up to 6 mm thickness) 2.13.1 Types 2.13.1.1 Filing 2.13.1.2 Grinding 2.13.1.3 Drilling 2.13.1.4 Reaming and tapping. 2.13.1.5 Sawing and cutting	

Learning Outcome	Content	Suggested Assessment Methods
	2.13.1.6 Gas welding 2.13.1.7 Spot welding 2.14 Procedure and applications 2.15 Fitting and assembly in sheet metal work (up to 6 mm thickness) 2.16 Types and applications of fasteners in sheet metal work 2.16.1 Bolts 2.16.2 Screws 2.16.3 Nuts 2.16.4 Rivets 2.17 Sheet metal pattern development 2.17.1 Methods 2.17.1.1 Parallel line method 2.18 Sheet metal products 2.18.1 Types 2.18.1.1 Tanks 2.18.1.2 Panels 2.18.1.3 Cabinets and boxes 2.18.1.4 Drums	

Learning Outcome	Content	Suggested Assessment Methods
	2.18.1.5 Tables and desks 2.18.2 Development and applications of sheet metal products **Practice** Carry out pattern development and produce: ❑ Panels ❑ Cans	
3. Carry out surface finishing operations	3.1 Grinding 3.2 Surface polishing 3.3 Surface painting	• Practical test • Project work • Written tests • Portfolio of evidence
4. Maintain fabrication tools, machines and equipment	1.1 Fabrication tools repair 1.1.1 Handles 1.1.2 Heads 1.1.3 Jaws 1.1.4 Blades 1.1.5 Discs and wheels 1.2 Preventive maintenance of fabrication machines and equipment 1.2.1 Cleaning of the external surfaces of the machine	• Practical test • Project work • Written tests • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	1.2.2 Inspecting cables, connectors and power sources 1.2.3 Lubricating of moving parts **Practice** ❑ Clean external surfaces of machine, tools and equipment ❑ Inspect cables, connectors and power sources ❑ Lubricate moving parts	

Suggested Delivery Methods

- ❑ Demonstration
- ❑ Group discussions
- ❑ Practical work.
- ❑ Exercises
- ❑ Industrial visits
- ❑ Online materials
- ❑ Direct instructions
- ❑ Simulation

List of Recommended Resources

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
1.	Textbooks	Comprehensive textbooks on Manual Metal Arc Welding (MMAW)	25	1:1
2.	Drawing papers	A4, A3 and A2 size drawing papers for drafting of sketches and working drawings	1 ream for each size	
3.	Projector	Functional projector for displaying content during presentations	1	1:25
4.	Computer	Functional desktop computer with online instructional content	1	1:25
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:25
6.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings	1	1:25
B	**Learning Facilities & Infrastructure**			
7.	Lecture/Theory Room	Spacious room with seats for 25 trainees, approximately 60 sqm	1	1:25
8.	Workshop	Standard workshop with bench/fitting area and welding booths approximately 80 sqm	1	1:25
C	**Materials and Supplies**			
9.	Dust coat/ overall	Shields skin and regular clothes from sparks	25	1:

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
10.	Gloves	Shields hands from sharp edges, heat, and chemical exposure	25	1:1
11.	Safety boots	Protects feet from heavy objects, sharp materials, and impact.	25	1:1
12.	Ear muffs/ ear plugs	Shields against prolonged exposure to high noise levels from machinery	25	1:1
13.	Safety goggles	Protects eyes from flying metal particles, sparks, and dust	25	1:1
14.	Raw materials	Steel Plates ❑ 4mm thickness. ❑ 6 mm thickness. Pipes ❑ 4 mm thickness ❑ 6 mm thickness Sheets ❑ Below 4 mm thickness		
15.	First Aid kit	Fully equipped First Aid kit for use in case of accidents	1	1:25
16.	Brooms and cleaning stuff	Hand brooms and mops for cleaning	10	2:5
17.	Cotton waste	Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment		
18.	Cleaning detergents	General degreasers	10 liters	
		Floor detergents	10 liters	

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
		Hand detergents	10 liters	
19.	Paints	Oil based paints	10 liters	
		Water based paints	10 liters	
20.	Coats	Undercoat	5 liters	
		First coat	5 liters	
		Second coat	5 liters	
		Clear coat	5 liters	
D	**Tools and Equipment**			
Measuring tools				
21.	GAS Welding/cutting outfit	-Welding Cylinders, -1⁄4″ x 20-Ft. Twin Hose,	5	1:5
22.	Cutting torch		5	1:5
23.	Heating torches		5	1:5
24.	LPG / Acetylene		1	1:25
25.	LPG / Oxygen		1	1:25
26.	Tip cleaners		5	1:5
27.	Spark lighter		2	1:12
28.	Spot welding machine		3	1:8
29.	Steel rules	Calibrated steel rules for linear measurements	20	4:5
30.	Vernier calipers	Calibrated vernier calipers for linear measurements	20	4:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
31.	Tri squares	Properly aligned steel Tri-square for checking perpendicular edges	5	1:5
32.	Vernier height gauge and surface plates	Calibrated vernier height gauges and surface plates for measurement of heights	5	1:5
33.	Measuring tapes	Calibrated measuring tapes for linear measurements	20	4:5
34.	Angle gauges	Calibrated steel rules for linear measurements	5	1:5
Marking out tools				
35.	Scribers	Quality steel pencil scribers for marking out lines on metal surfaces	20	4:5
36.	Dot punches	Quality steel dot punches for marking out centers	20	4:5
37.	Calipers	Quality steel calipers for marking out arcs on metal surfaces	5	1:5
Cutting Tools				
38.	Assorted hand files	Flat and round hand files for material preparation and finishing	20	4:5
39.	Hacksaws	Hack saws with functional frames and blades for cutting metal plates and pipes	20	4:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
40.	Tinsnips	Functional hand tinsnips for cutting metal sheets	10	2:5
41.	Angle grinders	Portable angle grinders with cutting and grinding disks for cutting and grinding metal plates and pipes	5	1:5
Work holding tools				
42.	Work benches	Stable work benches for carrying out bench work	5	1:5
43.	Bench vices	Functional bench vices/clamps for holding work pieces during bench work	20	4:5
44.	Tongs	Functional pairs of tongs for holding hot pieces of metal during welding	10	2:5
Finishing tools				
45.	Wire brushes	To clean metal surfaces	20	4:5
46.	File cards	Cleaning tool used to maintain files	5	1:5
E	**Machines and Equipment**			
47.	Guillotine machines	Used for cutting large sheets of metal into smaller pieces with precision	1	1:25
48.	Firefighting equipment	for ensuring safety in fabrication workshops where fire hazards are present, such as sparks	3	

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
49.	Rolling machines	used to bend and shape metal sheets into curved shapes, cylinders, or tubes	1	1:25
50.	Bending machine	used to bend metal sheets or bars into angles and specific shapes.	1	1:25
F	**Reference Materials**			
51.	Working drawings	Technical welding drawings giving the specifications of the welding to be carried out	25	1:1
52.	Operation sheets	Operation sheets describing the procedures to be followed in carrying out welding	25	1:1
53.	Welding Procedure Specifications (WPS)	WPS to guide on the procedure and standards to be used to achieve specific types of welds	25	1:1
54.	Training Presentations/Slides	Digital format for shared access among trainees	1	1:25
55.	Practical Assessment Guides	Worksheets for practical assessments	25	1:1

ARC WELDING PROCESSES I

Unit Code: 0715 251 11A

TVET CDACC UNIT CODE: ENG/CU/WEF/CR/02/3/MA

Unit Duration: 100 Hours

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Perform Arc Welding Processes I

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train arc welding processes. The learning outcomes involve carrying out manual metal arc welding, arc cutting process and maintaining arc welding machines, tools and equipment.

Summary of Learning Outcomes

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

S/NO	Learning Outcomes	Duration (Hours)
1.	Carry out manual metal arc welding (MMAW)	70
2.	Carry out arc cutting process	20
3.	Maintain welding machines, tools and equipment	10
Totals		**100**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Carry out Manual Metal Arc Welding (MMAW)	1.1 Occupational health and safety standards 1.1.1 Welding workshop safety 1.1.2 Welding workshop rules and regulations	• Practical test • Project work • Written tests Portfolio of evidence

	1.1.3 Personal protective equipment in welding 1.2 Hazards in welding 1.2.1 Types of hazards 1.2.2 Hazard control 1.3 Welding machines and tools safety 1.3.1 Types 1.3.2 Use 1.3.3 Care 1.4 Housekeeping in welding 1.4.1 Tools and materials storage 1.4.2 Workshop cleaning 1.4.3 Waste handling and disposal 1.5 MMAW machines, tools, equipment 1.5.1 Types 1.5.2 Use 1.5.3 Care 1.6 MMAW parameters 1.6.1 Setting 1.6.1.1 Current 1.6.1.2 Arc length 1.6.1.3 Arc force 1.6.1.4 Polarity 1.7 Materials used in welding 1.7.1 Welding Electrodes 1.7.1.1 Types 1.7.1.2 Flux coating 1.7.1.3 Coding 1.7.1.4 Applications 1.8 Forms of material supply 1.8.1 Types	

	1.8.1.1 Steel plates up to 6 mm thickness 1.8.1.2 Steel pipes up to 6 mm thickness 1.8.2 Applications 1.9 Welding drawing interpretation 1.9.1 Dimensions 1.9.2 Tolerances 1.9.3 Welding symbols and notations 1.9.4 Parts list 1.10 Material preparation in MMAW (up to 6 mm thickness) 1.10.1 Measuring 1.10.2 Marking out 1.10.3 Cutting 1.10.4 Edge preparation 1.11 Weld joints in MMAW 1.11.1 Types 1.11.1.1 Butt joint 1.11.1.2 Lap joint 1.11.1.3 Corner joint 1.11.1.4 T-joint 1.11.1.5 Cruciform joint 1.11.2 Geometry and applications 1.12 Welding positions in MMAW 1.12.1 Types 1.12.1.1 Flat 1.12.1.2 Horizontal 1.12.2 Description and applications	

	1.13 Weld defects in MMAW 1.13.1 Types 1.13.1.1 Porosity 1.13.1.2 Undercut 1.13.1.3 Incomplete penetration 1.13.1.4 Slag inclusion 1.13.1.5 Reinforcement 1.13.1.6 Spatters 1.13.1.7 Weld craters 1.13.1.8 Weld cracks 1.13.1.9 Distortion 1.13.2 Causes and prevention 1.14 Arc welded product finishing processes 1.14.1 Methods 1.14.1.1 Grinding 1.14.1.2 Varnishing 1.14.1.3 Oil blacking 1.14.1.4 Painting 1.14.2 Applications of MMAW finishing processes **Practice** ❑ Arc weld mild steel plates and pipes of up to 6 mm thickness in: • Flat position • Horizontal position	

2. Carry out arc cutting process	2.1 Arc cutting parameters 2.1.1 Setting 2.1.1.1 Current 2.1.1.2 Electrodes 2.2 Arc cutting process (up to 6 mm thickness) 2.2.1 Procedure 2.2.2 Applications 2.3 Edge finishing after arc cutting (up to 6 mm thickness) 2.3.1 Type 2.3.2 Procedure 2.3.3 Application **Practice** ❑ Arc cut mild steel plates and pipes of: • 4 mm thickness in flat position	• Practical test • Project work • Written tests Portfolio of evidence
3. Maintain welding machines, tools and equipment	3.1 Welding tools repair 3.1.1 Handles 3.1.2 Heads 3.1.3 Jaws 3.1.4 Blades 3.1.5 Discs and wheels 3.2 Preventive maintenance of fabrication machines and equipment 3.2.1 Cleaning of the external surfaces of the machine 3.2.2 Inspecting cables, connectors and power sources 3.2.3 Lubricating of moving parts **Practice**	• Practical test • Project work • Written tests Portfolio of evidence

	❑ Clean external surfaces of machine ❑ Inspect cables, connectors and power sources ❑ Lubricate moving parts	

Suggested Delivery Methods

- ❑ Demonstration
- ❑ Group discussions
- ❑ Practical work
- ❑ Exercises
- ❑ Direct instructions
- ❑ Industrial visits
- ❑ Online materials
- ❑ Simulation

List of Recommended Resources

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Textbooks on Manual Metal Arc Welding (MMAW)	25	1:1
	Drawing papers	A4, A3 and A2 size drawing papers for drafting of sketches and working drawings	1 ream	
	Projector	Functional projector for displaying content during presentations	1	1:25
	Computer	Functional desktop computer with online instructional content	1	1:25

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
	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**			
	PPEs	Quality PPE for personal protection during welding and fabrication:		
		Dust coats	25	1:1
		Leather aprons	25	1:1
		Face shield	25	1:1
		Overalls	25	1:1
		Leather gloves	25	1:1
		Safety boots	25	1:1
		Goggles	25	1:1
	Raw materials	Steel and aluminum Plates ❑ 4mm thickness. ❑ 6 mm thickness. ❑ 9 mm thickness. ❑ 12 mm thickness.		

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
		Pipes ❑ 4 mm thickness ❑ 6 mm thickness ❑ 9 mm thickness		
	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	
	Electrodes	2.5 mm and 3.2 mm rutile (fill-freeze) electrodes	50 pkts	
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

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
	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	Quality steel pencil scribers for marking out lines on metal surfaces	20	4:5
	Dot punches	Quality steel dot punches for marking out centres	20	4:5
	Calipers	Quality steel calipers for marking out arcs on metal surfaces	5	1:5
Cutting Tools				
	Assorted hand files	Flat and round hand files for material preparation and finishing	20	4:5
	Hacksaws	Hack saws with functional frames and blades for cutting metal plates and pipes	20	4:5
	Angle grinders	Portable angle grinders with cutting and grinding disks for cutting and grinding metal plates and pipes	5	1:5
Work holding tools				

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
	Work benches	Stable work benches for carrying out bench work	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	Steel wire brushes for cleaning metal surfaces and welds	20	4:5
	Chipping hammers	Metal chipping hammers for removing spatters and slags from welds	10	2:5
	File cards	High grade hardened steel file cards for cutting and smoothing metal edges and surfaces	5	1:5
E	**Machines and Equipment**			
	Arc welding machines	DC welding machine	10	2:5
	Firefighting extinguishers	Water, carbon dioxide and chemical powder fire extinguishers for fire fighting	1	1:25
	Electrode cabinet/oven	Functional electrode oven and cabinet for baking and storage of electrodes	1	1:25

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
	Welding fixtures	Steel welding fixtures/magnets for securing workpieces during welding	10	2:5
F	**Reference Materials**			
	Working drawings	Technical welding drawings giving the specifications of the welding to be carried out	25	1:1
	Operation sheets	Operation sheets describing the procedures to be followed in carrying out welding	25	1:1
	Welding Procedure Specifications (WPS)	WPS to guide on the procedure and standards to be used to achieve specific types of welds	25	1:1
	Training Presentations/Slides	Digital format for shared access among trainees	1	1:25
	Practical Assessment Guides	Worksheets for practical assessments	25	1:1

GAS WELDING, SOLDERING AND BRAZING

Unit Code: 0715 251 12A

TVET CDACC UNIT CODE: ENG/CU/WEF/CR/03/3/MA

Unit Duration: 100 Hours

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Perform Gas Welding, Soldering and Brazing

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train gas welding. The learning outcomes involve applying communication skills, carrying out gas welding, gas cutting, brazing, soldering and maintaining gas welding machines, tools and equipment.

Summary of Learning Outcomes

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

S/No.	Learning Outcomes	Duration (Hours)
1.	Carry out gas welding	40
2.	Carry out gas cutting	10
3.	Carry out brazing	20
4.	Carry out soldering	20
5.	Maintain gas welding machines, tools and equipment	10
Totals		**100**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply communication skills	1.1 Principles of effective communication in welding: 1.1.1 Courtesy 1.1.2 Correctness	• Written assessment • Oral assessment • Observation

Learning Outcome	Content	Suggested Assessment Methods
	1.1.3 Consideration 1.1.4 Clarity 1.1.5 Completeness 1.2 Communication barriers in welding: 1.2.1 Language 1.2.2 Physical 1.2.3 Channel 1.3 Flow of communication in welding workplace: 1.3.1 Downward 1.3.2 Upward 1.4 Sources of information in welding workplace: 1.4.1 Employee 1.4.2 Customers' feedback 1.4.3 Organization documents 1.5 Welding drawing interpretation 1.5.1 Dimensions 1.5.2 Tolerances 1.5.3 Welding symbols and notations 1.5.4 Parts list 1.6 Digital communication 1.6.1 E-Portfolio 1.6.2 Communication to clients 1.7 Basic Costing	• Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	1.7.1 Materials 1.7.2 Labour Product pricing	
2. Carry out gas welding	2.1 Occupational health and safety standards Workshop safety 2.1.1 Workshop rules and regulations 2.1.2 Personal protective equipment in gas welding 2.2 Gas welding hazards 2.2.1 Types of hazards 2.2.2 Hazard control 2.3 Gas welding machines and tools safety 2.4 Housekeeping in gas welding 2.4.1 Tools and materials storage 2.4.2 Workshop cleaning 2.4.3 Waste handling and disposal 2.5 Gas welding equipment and accessories 2.5.1 Equipment and accessories 2.5.1.1 Oxygen cylinders 2.5.1.2 Acetylene cylinder 2.5.1.3 Propane cylinder 2.5.1.4 Welding torch 2.5.1.5 Regulators	• Practical test • Project work • Written tests • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	2.5.1.6 Hoses 2.5.1.7 Jigs and fixtures 2.5.2 Use and care 2.6 Gas welding tools 2.6.1 Types 2.6.1.1 Nozzle cleaner 2.6.1.2 Lighter 2.6.2 Use and care 2.7 Welding material preparation (steel up to 6 mm thickness) 2.7.1 Measuring 2.7.2 Marking out 2.7.3 Cutting 2.7.4 Edge preparation 2.8 Gas welding parameters 2.8.1 Setting 2.8.1.1 Working pressure 2.8.1.2 Oxygen-fuel ratio 2.9 Materials (Steel up to 6 mm thickness) 2.9.1.1 Plates 2.9.1.2 Pipes 2.10 Welding positions 2.10.1 Types 2.10.1.1 Flat 2.10.1.2 Horizontal 2.10.2 Description and applications 2.11 Weld joints	

Learning Outcome	Content	Suggested Assessment Methods
	2.11.1 Types 2.11.1.1 Butt joint 2.11.1.2 Lap joint 2.11.1.3 Corner joint 2.11.1.4 T-joint 2.11.1.5 Cruciform joint 2.11.2 Geometry and applications 2.12 Gas welding faults 2.12.1 Types 2.12.1.1 Flash back 2.12.1.2 Back fire 2.12.1.3 Leakages 2.12.2 Causes and prevention 2.13 Gas welding defects 2.13.1 Types 2.13.1.1 Porosity 2.13.1.2 Undercut 2.13.1.3 Incomplete penetration 2.13.1.4 Reinforcement 2.13.1.5 Spatters 2.13.1.6 Weld craters 2.13.1.7 Weld cracks 2.13.1.8 Distortion 2.13.2 Causes and prevention 2.14 Finishing processes in gas welding 2.14.1 Methods 2.14.1.1 Polishing	

Learning Outcome	Content	Suggested Assessment Methods
	2.14.1.2 Grinding 2.14.1.3 Varnishing 2.14.1.4 Oil blacking 2.14.1.5 Deburring 2.14.1.6 Painting 2.14.2 Procedure and application **Practice** ❑ Gas weld mild steel plates and pipes of up to 6 mm thickness • Flat position • Horizontal position	
3. Carry out gas cutting	3.1 Gas cutting tools and equipment 3.1.1 Cutting torch 3.1.1.1 Use 3.1.1.2 Care 3.2 Fuel gas in gas cutting 3.2.1 Types 3.2.2 Applications 3.3 Gas cutting material preparation (steel up to 6 mm thickness) 3.3.1 Measuring 3.3.2 Marking out 3.4 Gas cutting process on steel up to 6 mm thickness 3.4.1 Procedure 3.4.2 Applications **Practice**	• Practical test • Project work • Written tests • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	❑ Gas cut mild steel plates and pipes of: • Up to 6 mm thickness in flat position	
4. Carry out brazing	4.1 Brazing tools and equipment 4.1.1 Types 4.1.2 Uses 4.1.3 Care 4.2 Types and uses of brazing materials 4.2.1 Fluxes 4.2.2 Spelter 4.3 Brazing parameters 4.3.1 Setting 4.3.1.1 Working pressure 4.3.1.2 Oxy-fuel ratio 4.4 Brazing process 4.4.1 Procedure 4.4.2 Applications **Practice** ❑ Braze mild steel sheet metal, plates and pipes of: • Up to 4 mm thickness in flat position	• Practical test • Project work • Written tests • Portfolio of evidence
1. Carry out soldering	5.1 Soldering tools and equipment 5.1.1 Types 5.1.2 Uses 5.1.3 Care and storage	• Practical test • Project work • Written tests • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	5.2 Applications of soldering materials 5.2.1 Fluxes 5.2.2 Solder 5.3 Setting soldering parameters 5.3.1 Temperature 5.3.2 Pressure 5.4 Soldering process 5.4.1 Procedure 5.4.2 Types of soldering operations 5.4.3 Applications **Practice** ❑ Solder steel, aluminium, copper and titanium plates and pipes of up to 4 mm thickness in: • Flat position 5.5 Horizontal position	
2. Maintain gas welding machines, tools and equipment	6.1 Welding tools repair 6.1.1 Heads 6.1.2 Handles 6.1.3 Jaws 6.1.4 Blades 6.1.5 Discs and wheels 6.2 Preventive maintenance of fabrication machines and equipment 6.2.1 Cleaning of the external surfaces of the machine	• Practical test • Project work • Written tests • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	6.2.2 Inspecting cables, connectors and power sources 6.2.3 Lubricating of moving parts **Practice** ❑ Clean external surfaces of machine, tools and equipment ❑ Inspect cables, connectors and power sources ❑ Lubricate moving parts	

Suggested Delivery Methods

- Demonstration
- Group discussions
- Practical work.
- Exercises
- Industrial visits
- Online materials
- Direct instructions
- Simulation

List of Recommended Resources

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Texts books on Gas Welding processes	5	1:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
2.	Installation Manuals	Detailed guides for equipment installation and troubleshooting	5	1:5
3.	PowerPoint Presentations	For trainer's use, covering course content and practical applications	1	1:25
4.	Drawing papers	A4, A3 and A2 size drawing papers for drafting of sketches and working drawings	1 ream of each size	
5.	Working drawings	Printed per project	25	1:1
6.	Operation sheets	Per project	25	1:1
7.	Projector	Functional projector for displaying content during presentations	1	1:25
8.	Computer	Functional desktop computer with online instructional content	1	1:25
9.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:25
10.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings	1	1:25
11.	Templates	Per project	5	1:5
B	**Learning Facilities & Infrastructure**			
12.	Lecture/Theory Room /Learning Resource	Spacious, equipped with projectors and Seats for 25	1	1:25

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
	Area*	trainees, approximately 45 sqm (5 m x 9 m)		
13.	Standard workshop	Hands-on training area with workbenches, tools, and safety equipment, approximately 80 sqm	1	1:25
14.	Grinding Booth*	2 m x 1.5 m	1	
15.	Materials/Preparation Area*	2 m x 2 m	1	
16.	Bench work Area*	1.5 m x 2.5 m	1	
17.	Wash Area /Comfort Room *(male & female)**	2.5 m x 4 m	1	
18.	Tool Room & S/M Storage Area*	4 m x 5 m	1	
C	**Consumable Materials**			
19.	Pipes	Steel pipes of 4, 6 mm thickness	Enough	
20.	Plates	Steel plates 4, 6 mm thickness	Enough	
21.	Sheets	Up to gauge 18	Enough	
22.	Dark glass	For gas welding	3	1: 8
23.	Cut off disc	3/32” x 5/8" x 4" dia.	25	1:1
24.	Filler (alloy) rod	1.6/2.4 mm dia.	Enough	
25.	Insulation Tapes	For securing connections and insulation, assorted colors	25	1:1
26.	Cotton waste	For cleaning	Enough	
27.	Cleaning detergents	General degreasers Floor detergents	Enough	

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
		Hand detergents		
28.	Spelter	General Brazing Silver Brazing (brass/stainless)	Enough	
29.	Solders	Soft Solders Hard solders	Enough	
30.	Fluxes	Corrosive Non-corrosive	Enough	
31.	Electrodes	2.5 mm and 3.2 mm rutile (fill-freeze) electrodes	50 pkts	
D	**Tools and Equipment**			
32.	GAS Welding/cutting outfit	-Welding Cylinders, -1⁄4″ x 20-Ft. Twin Hose,	5	1:5
33.	Arc welding machines	DC welding machine	10	2:5
34.	Spot welding machine		3	1:8
35.	Tape Measures	5 m tape measures for accurate measurement	5	1:5
36.	Cutting torch		5	1:5
37.	Heating torches		5	1:5
38.	Welding tips		15	
39.	First Aid kit		1	
40.	Portable disc Grinder/angle grinders		5	1:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
41.	Exhaust fan		1	1:25
42.	Work bench	W/Bench Vice On 4 Corners	4	1:6
43.	LPG / Acetylene		1	1:25
44.	LPG / Oxygen		1	1:25
45.	Pipe beveling machine		1	1:25
46.	Fire-fighting equipment		3	
47.	Tip cleaners		5	1:5
48.	Spark lighter		2	1:12
49.	Jigs and fixtures		5	1:5
50.	Screwdrivers		5	1:5
51.	Pliers /Cutters		5	1:5
52.	Chipping Hammer		5	1:5
53.	Steel Brush		5	1:5
54.	Files Bastard		5	1:5
55.	Scribers		5	1:5
56.	Dot Punches		5	1:5
57.	Try Square		5	1:5
58.	Steel Rule	300 mm long	20	2:5
59.	Filler Gauge		5	1:5
60.	Wire Cutter		5	1:5
61.	Hand Hacksaw		20	2:5
62.	Measuring Tapes		20	2:5
E	**PPE (Personal Protective Equipment)**			
63.	Leather apron/jacket	Body protection	25	1:1
64.	Helmets	Head protection	25	1:1

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
65.	Gloves	Hand protection	25	1:1
66.	Safety goggles wide vision	Face /Eye protection	25	1:1
67.	Safety shoes	Foot protection	25	1:1
F	**Reference Materials**			
68.	Welding blueprint /drawings and standards	Reference on industry standards (e.g., BS/ANSI/AWS etc)	5	1:5
69.	Training Presentations/Slides	Digital format for shared access among trainees	1	1:25
70.	Multimedia Learning Modules	Digital licenses for videos and tutorials	25	1:1
71.	Practical Assessment Guides	Worksheets for practical assessments	25	1:1

***** *This area can also be used by other welding courses.*

MODULE II

METAL INERT GAS WELDING

Unit Code: 0715 351 13A

TVET CDACC UNIT CODE: ENG/CU/WEF/CR/01/4/MA

Unit Duration: 200 Hours

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Perform Metal Inert Gas (MIG) Welding

Unit Description
This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train MIG welding. The learning outcomes involve drafting working drawing, carrying out metal inert gas (MIG) welding and maintaining MIG welding machines, tools and equipment

Summary of Learning Outcomes

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

S/NO	Learning Outcomes	Duration (Hours)
1.	Draft working drawing	40
2.	Carry out Metal Inert Gas (MIG) welding	140
3.	Maintain MIG welding machines, tools and equipment	20
Total		**200**

1. Draft working drawing
2. Carry out Metal Inert Gas (MIG) welding
3. Maintain MIG welding machines, tools and equipment

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Draft working drawing	1.1 Drawing interpretation 1.1.1 Dimensions 1.1.1.1 Linear 1.1.1.2 Angular	• Written tests • Practical test

Learning Outcome	Content	Suggested Assessment Methods
	1.1.2 Tolerances 1.1.3 Symbols and notations 1.1.4 Views/Elevations 1.1.4.1 First angle 1.1.4.2 Third angle 1.1.5 Scale 1.1.6 Measurement of angles 1.1.7 Sketching of plane geometric forms 1.1.7.1 Triangles 1.1.7.2 Quadrilaterals 1.1.7.3 Polygons 1.1.7.4 Circles and tangents 1.1.8 Solids sketches 1.1.8.1 Prisms 1.1.8.2 Cones 1.1.8.3 Cubes 1.1.8.4 Cuboids Cylinders 1.2 Draft work drawings 1.2.1 Drawing dimension 1.2.2 Welding symbols and notations 1.3 Operation procedure 1.3.1 Development 1.3.2 Use **Practice** ❑ Draft working drawing	• Project work Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	❑ Prepare operation plan	
2. Carry out Metal inert Gas (MIG) welding	2.1 Occupational health and safety standards 2.1.1 Workshop safety 2.1.2 Personal protective equipment 2.1.3 Workplace procedures 2.2 Welding hazards 2.2.1 Types 2.2.2 Prevention and control 2.3 Safe handling of equipment 2.4 Housekeeping 2.4.1 Cleaning 2.4.2 Waste Management 2.5 Interpretation of working drawing 2.5.1 Symbols and notations 2.5.2 Abbreviations 2.5.3 Parts list 2.6 MIG welding equipment and accessories 2.6.1 Types 2.6.1.1 Inert gas cylinders 2.6.1.2 MIG welding machine 2.6.1.2.1 MIG wire 2.6.1.2.2 MIG torch 2.6.2 Use and care 2.7 MIG welding tools	• Practical test • Project work • Written tests • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	2.7.1 Types 2.7.1.1 Fire extinguishers 2.7.1.2 Welding jigs and fixtures 2.7.1.3 Nozzle cleaner 2.7.1.4 Wire brush 2.7.2 Use and care 2.8 Welding material preparation (steel up to 10 mm thickness) 2.8.1 Measuring 2.8.2 Marking out 2.8.3 Cutting 2.8.4 Edge preparation 2.9 MIG welding parameters 2.9.1 Setting 2.9.1.1 Pre-operation checks 2.9.1.2 Working pressure 2.9.1.3 Current 2.9.1.4 Torch angle 2.9.1.5 Wire speed 2.9.1.6 Wire gauge/diameter 2.10 Modes of metal transfer 2.10.1 Short circuit 2.10.2 Globular 2.10.3 Spray arc 2.10.4 Pulsed 2.11 Metallic Materials (up to 10 mm thickness)	

Learning Outcome	Content	Suggested Assessment Methods
	2.11.1 Plates 2.11.2 Pipes 2.12 Welding positions 2.12.1 Types 2.12.1.1 Flat 2.12.1.2 Horizontal 2.12.1.3 Vertical 2.12.2 Applications 2.11 Types of joints 2.11.1 Types 2.11.1.1 Butt joint 2.11.1.2 Edge joint 2.11.1.3 Plug joint 2.11.1.4 Lap joint 2.11.1.5 Corner joint 2.11.1.6 T-joint 2.11.1.7 Cruciform joint 2.11.2 Geometry and applications 2.12 Weld defects 2.12.1 Types 2.12.1.1 Porosity 2.12.1.2 Undercut 2.12.1.3 Incomplete penetration 2.12.1.4 Reinforcement 2.12.1.5 Spatters 2.12.1.6 Weld craters	

Learning Outcome	Content	Suggested Assessment Methods
	2.12.1.7 Weld cracks 2.12.1.8 Distortion 2.12.2 Causes and prevention 2.13 Finishing processes 2.13.1 Types 2.13.1.1 Polishing 2.13.1.2 Grinding 2.13.1.3 Blueing 2.13.1.4 Varnishing 2.13.1.5 Oil blacking 2.13.1.6 Deburring 2.13.1.7 Painting 2.13.2 Procedure and applications **Practice** ❑ MIG weld metallic materials up to 10 mm thickness in: • Flat position • Horizontal position • Vertical position	
3 Maintain MIG welding machines, tools and equipment	3.1 Welding tools repair 3.1.1 Heads 3.1.2 Handles 3.1.3 Jaws 3.1.4 Blades 3.1.5 Discs and wheels 3.2 Preventive maintenance of fabrication machines and equipment	• Practical test • Project work • Written tests • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	3.2.1 Cleaning of the external surfaces of the machine 3.2.2 Inspecting cables, connectors and power sources 3.2.3 Lubricating of moving parts **Practice** ❑ Clean external surfaces of machines, tools and equipment ❑ Inspect cables, connectors and power sources ❑ Lubricate moving parts	

Suggested Delivery Methods

- ❑ Demonstration
- ❑ Group discussions
- ❑ Practical work.
- ❑ Exercises
- ❑ Industrial visits
- ❑ Online materials
- ❑ Direct instructions
- ❑ Simulation

List of Recommended Resources

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Textbooks on Welding and Fabrication	25	1:1
2.	Drawing papers	A4, A3 and A2 size drawing papers for drafting of sketches and working drawings	1 ream for each size	
3.	Projector	Functional projector for displaying content during presentations	1	1:25
4.	Computer	Functional desktop computer with online instructional content	1	1:25
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:25
6.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings	1	1:25
B	**Learning Facilities & Infrastructure**			
7.	Lecture/Theory Room	Spacious room with seats for 25 trainees, approximately 60 sqm	1	1:25
8.	Workshop	Standard workshop with bench/fitting area and welding booths approximately 80 sqm	1	1:25
C	**Materials and Supplies**			
9.	Dust coat/ overall	Shields skin and regular clothes from sparks	25	1:
10.	Gloves	Shields hands from sharp edges, heat, and chemical exposure	25	1:1
11.	Safety boots	Protects feet from heavy objects, sharp materials, and impact.	25	1:1
12.	Welding helmets	Protecting the eyes while providing a clear view of the weld.	25	1:1

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
13.	Ear muffs/ ear plugs	Shields against prolonged exposure to high noise levels from machinery	25	1:1
14.	Safety goggles	Protects eyes from flying metal particles, sparks, and dust	25	1:1
15.	Raw materials	Metallic materials Plates ❑ 4mm thickness. ❑ 6 mm thickness. ❑ 9 mm thickness. ❑ 12 mm thickness. Pipes ❑ 4 mm thickness ❑ 6 mm thickness ❑ 9 mm thickness ❑ 12 mm thickness		
16.	Tungsten electrodes	Electrodes used in TIG welding	20 packets	
17.	First Aid kit	Fully equipped First Aid kit for use in case of accidents	1	1:25
18.	Brooms and cleaning stuff	Hand brooms and mops for cleaning	10	2:5
19.	Cotton waste	Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment	Enough	
20.	Cleaning detergents	General degreasers	10 liters	
		Floor detergents	10 liters	
		Hand detergents	10 liters	
D	**Tools and Equipment**			
Measuring tools				
21.	Steel rules	Calibrated steel rules for linear measurements	20	4:5
22.	Vernier calipers	Calibrated vernier calipers for linear measurements	20	4:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
23.	Tri squares	Properly aligned steel Tri-square for checking perpendicular edges	5	1:5
24.	Vernier height gauge and surface plates	Calibrated vernier height gauges and surface plates for measurement of heights	5	1:5
25.	Measuring tapes	Calibrated measuring tapes for linear measurements	20	4:5
26.	Angle gauges	Calibrated steel rules for linear measurements	5	1:5
Marking out tools				
27.	Scribers	Quality steel pencil scribers for marking out lines on metal surfaces	20	4:5
28.	Dot punches	Quality steel dot punches for marking out centres	20	4:5
29.	Calipers	Quality steel calipers for marking out arcs on metal surfaces	5	1:5
Cutting Tools				
30.	Assorted hand files	Flat and round hand files for material preparation and finishing	20	4:5
31.	Hacksaws	Hack saws with functional frames and blades for cutting metal plates and pipes	20	4:5
32.	Tinsnips		10	2:5
33.	Angle grinders	Portable angle grinders with cutting and grinding disks for cutting and grinding metal plates and pipes	5	1:5
Work holding tools				
34.	Work benches	Stable work benches for carrying out bench work	5	1:5
35.	Collet	Hold the tungsten electrode in place	5	1:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
36.	Bench vices	Functional bench vices/clamps for holding work pieces during bench work	20	4:5
37.	Tongs	Functional pairs of tongs for holding hot pieces of metal during welding	10	2:5
		Finishing tools		
38.	Wire brushes	To clean metal surfaces	20	4:5
39.	MIG welding wire	Acts as both the electrode and the filler material	2000kg	80:1
40.	File cards	Cleaning tool used to maintain files	5	1:5
E	**Machines and Equipment**			
41.	MIG/ MAG welding machine	Uses a continuous wire feed as an electrode	5	1:5
42.	Firefighting equipment	For ensuring safety in fabrication workshops where fire hazards are present, such as sparks	3	
43.	Welding gun	Feeds the filler wire into the weld pool	5	1:5
F	**Reference Materials**			
44.	Working drawings	Technical welding drawings giving the specifications of the welding to be carried out	25	1:1
45.	Operation sheets	Operation sheets describing the procedures to be followed in carrying out welding	25	1:1
46.	Welding Procedure Specifications (WPS)	WPS to guide on the procedure and standards to be used to achieve specific types of welds	25	1:1
47.	Training Presentations/Slides	Digital format for shared access among trainees	1	1:25
48.	Practical Assessment Guides	Worksheets for practical assessments	25	1:1

TUNGSTEN INERT GAS WELDING

Unit Code: 0715 351 14A

TVET CDACC UNIT CODE: ENG/CU/WEF/CR/02/4/MA

Unit Duration: 200 Hours

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Perform Tungsten Inert Gas Welding

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train TIG welding. The learning outcomes involve drafting working drawing, carrying out Tungsten Inert Gas (TIG) welding, and maintaining gas metal arc welding equipment

Summary of Learning Outcomes

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

S/NO	Learning Outcomes	Duration (Hours)
1.	To draft working drawing	40
2.	To Carry out Tungsten Inert Gas (TIG) welding	140
3.	To Maintain TIG welding machines, tools and equipment	20
Totals		**200**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Draft working drawing	1.1 Drawing interpretation 1.1.1 Dimensions 1.1.1.1 Linear 1.1.1.2 Angular 1.1.2 Tolerances 1.1.3 Symbols and notations 1.1.4 Views/Elevations 1.1.4.1 First angle	• Written tests • Practical test • Project work • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	1.1.4.2 Third angle 1.1.5 Scale 1.1.6 Measurement of angles 1.1.7 Sketching of plane geometric forms 1.1.7.1 Triangles 1.1.7.2 Quadrilaterals 1.1.7.3 Polygons 1.1.7.4 Circles and tangents 1.1.8 Solids sketches 1.1.8.1 Prisms 1.1.8.2 Cones 1.1.8.3 Cubes 1.1.8.4 Cuboids Cylinders 1.2 Draft work drawings 1.2.1 Drawing dimension 1.2.2 Welding symbols and notations 1.3 Operation procedure 1.3.1 Development 1.3.2 Use **Practice** ❑ Draft working drawing ❑ Prepare operation plan	
2. Carry out Tungsten Inert	2.1 Occupational health and safety standards	• Practical test • Project work

Learning Outcome	Content	Suggested Assessment Methods
Gas (TIG) welding	2.1.1 Personal protective equipment 2.1.2 Workshop safety 2.1.3 Workplace procedures 2.1.4 Welding hazards 2.1.4.1 Types 2.1.4.2 Prevention and control 2.1.5 Safe handling of equipment 2.2 Housekeeping 2.2.1 Cleaning 2.2.2 Waste management 2.3 Interpretation of working drawing 2.3.1 Symbols and notations 2.3.2 Abbreviations 2.3.3 Parts list 2.4 TIG welding equipment and accessories 2.4.1 Types 2.4.1.1 TIG torch 2.4.1.2 Inert gas cylinders 2.4.1.3 Tungsten electrode 2.4.1.4 Filler rods 2.4.2 Uses and care 2.5 Welding material preparation (up to 10 mm thickness) 2.5.1 Measuring 2.5.2 Marking out 2.5.3 Cutting	• Written tests • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	2.5.4 Edge preparation 2.6 TIG welding parameters 2.6.1 Setting 2.6.1.1 Current 2.6.1.2 Arc force 2.6.1.3 Voltage 2.6.1.4 Gas pressure 2.7 MIG welding tools 2.7.1 Types 2.7.1.1 Fire extinguishers 2.7.1.2 Welding jigs and fixtures 2.7.1.3 Nozzle cleaner 2.7.2 Use and care 2.8 TIG welding process 2.8.1 Procedure 2.8.2 Applications 2.9 Metallic Materials (up to 10 mm thickness) 2.9.1.1 Plates 2.9.1.2 Pipes 2.10 Welding positions 2.10.1 Types 2.10.1.1 Flat 2.10.1.2 Horizontal 2.10.1.3 Vertical 2.10.2 Applications 2.11 Types of joints 2.11.1 Types	

Learning Outcome	Content	Suggested Assessment Methods
	2.11.1.1 Butt joint 2.11.1.2 Lap joint 2.11.1.3 Corner joint 2.11.1.4 T-joint 2.11.1.5 Cruciform joint 2.11.2 Geometry and applications 2.12 Weld defects 2.12.1 Types 2.12.1.1 Porosity 2.12.1.2 Undercut 2.12.1.3 Incomplete penetration 2.12.1.4 Reinforcement 2.12.1.5 Spatters 2.12.1.6 Weld craters 2.12.1.7 Weld cracks 2.12.1.8 Distortion 2.12.2 Causes and prevention 2.13 Finishing processes 2.13.1 Types 2.13.1.1 Polishing 2.13.1.2 Grinding 2.13.1.3 Blueing 2.13.1.4 Varnishing 2.13.1.5 Oil blacking 2.13.1.6 Deburring 2.13.1.7 Painting 2.13.2 Procedure and applications	

Learning Outcome	Content	Suggested Assessment Methods
	Practice ❑ TIG weld metallic materials plates and pipes of up to 10 mm thickness in: • Flat position • Horizontal position • Vertical position	
3. Maintain TIG welding machines, tools and equipment	3.1 Welding tools repair 3.1.1 Heads 3.1.2 Handles 3.1.3 Jaws 3.1.4 Blades 3.1.5 Discs and wheels 3.2 Preventive maintenance of fabrication machines and equipment 1.2.1 Cleaning of the external surfaces of the machine 1.2.2 Inspecting cables, connectors and power sources 1.2.3 Lubricating of moving parts **Practice** ❑ Clean external surfaces of machine, tools and equipment ❑ Inspect cables, connectors and power sources ❑ Lubricate moving parts	• Practical test • Project work • Written tests • Portfolio of evidence

Suggested Delivery Methods

❑ Demonstration

- Group discussions
- Practical work.
- Exercises
- Industrial visits
- Online materials
- Direct instructions
- Simulation

List of Recommended Resources

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Textbooks on Welding and Fabrication	25	1:1
2.	Drawing papers	A4, A3 and A2 size drawing papers for drafting of sketches and working drawings	1 ream for each size	
3.	Projector	Functional projector for displaying content during presentations	1	1:25
4.	Computer	Functional desktop computer with online instructional content	1	1:25
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:25
6.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing	1	1:25

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
		notes, instructions and working drawings		
B	**Learning Facilities & Infrastructure**			
7.	Lecture/Theory Room	Spacious room with seats for 25 trainees, approximately 60 sqm	1	1:25
8.	Workshop	Standard workshop with bench/fitting area and welding booths approximately 80 sqm	1	1:25
C	**Materials and Supplies**			
9.	Dust coat/ overall	Shields skin and regular clothes from sparks	25	1:
10.	Gloves	Shields hands from sharp edges, heat, and chemical exposure	25	1:1
11.	Safety boots	Protects feet from heavy objects, sharp materials, and impact.	25	1:1
12.	Welding helmets	Protecting the eyes while providing a clear view of the weld.	25	1:1
13.	Ear muffs/ ear plugs	Shields against prolonged exposure to high noise levels from machinery	25	1:1
14.	Safety goggles	Protects eyes from flying metal particles, sparks, and dust	25	1:1
15.	Raw materials	Metallic Materials Plates		

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
		❑ 4mm thickness. ❑ 6 mm thickness. ❑ 9 mm thickness. ❑ 12 mm thickness. Pipes ❑ 4 mm thickness ❑ 6 mm thickness ❑ 9 mm thickness ❑ 12 mm thickness		
16.	Tungsten electrodes	Electrodes used in TIG welding	20 packets	
17.	First Aid kit	Fully equipped First Aid kit for use in case of accidents	1	1:25
18.	Brooms and cleaning stuff	Hand brooms and mops for cleaning	10	2:5
19.	Cotton waste	Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment	Enough	
20.	Cleaning detergents	General degreasers	10 liters	
		Floor detergents	10 liters	
		Hand detergents	10 liters	
D	**Tools and Equipment**			
Measuring tools				
21.	Steel rules	Calibrated steel rules for linear measurements	20	4:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
22.	Vernier calipers	Calibrated vernier calipers for linear measurements	20	4:5
23.	Tri squares	Properly aligned steel Tri-square for checking perpendicular edges	5	1:5
24.	Vernier height gauge and surface plates	Calibrated vernier height gauges and surface plates for measurement of heights	5	1:5
25.	Measuring tapes	Calibrated measuring tapes for linear measurements	20	4:5
26.	Angle gauges	Calibrated steel rules for linear measurements	5	1:5
Marking out tools				
27.	Scribers	Quality steel pencil scribers for marking out lines on metal surfaces	20	4:5
28.	Dot punches	Quality steel dot punches for marking out centers	20	4:5
29.	Calipers	Quality steel calipers for marking out arcs on metal surfaces	5	1:5
Cutting Tools				
30.	Assorted hand files	Flat and round hand files for material preparation and finishing	20	4:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
31.	Hacksaws	Hack saws with functional frames and blades for cutting metal plates and pipes	20	4:5
32.	Tinsnips		10	2:5
33.	Angle grinders	Portable angle grinders with cutting and grinding disks for cutting and grinding metal plates and pipes	5	1:5
Work holding tools				
34.	Work benches	Stable work benches for carrying out bench work	5	1:5
35.	Collet	Hold the tungsten electrode in place	5	1:5
36.	Bench vices	Functional bench vices/clamps for holding work pieces during bench work	20	4:5
37.	Tongs	Functional pairs of tongs for holding hot pieces of metal during welding	10	2:5
Finishing tools				
38.	Wire brushes	To clean metal surfaces	20	4:5
39.	TIG welding wire	Used as filler rods	200kg	8:1
40.	File cards	Cleaning tool used to maintain files	5	1:5
E	**Machines and Equipment**			
41.	TIG welding machine	Uses a non-consumable tungsten electrode	5	1:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
42.	Firefighting equipment	for ensuring safety in fabrication workshops where fire hazards are present, such as sparks	3	
43.	Welding gun	Feeds the filler wire into the weld pool	5	1:5
F	**Reference Materials**			
44.	Working drawings	Technical welding drawings giving the specifications of the welding to be carried out	25	1:1
45.	Operation sheets	Operation sheets describing the procedures to be followed in carrying out welding	25	1:1
46.	Welding Procedure Specifications (WPS)	WPS to guide on the procedure and standards to be used to achieve specific types of welds	25	1:1
47.	Training Presentations/Slides	Digital format for shared access among trainees	1	1:25
48.	Practical Assessment Guides	Worksheets for practical assessments	25	1:1

MODULE III

COMMUNICATION SKILLS

UNIT CODE: 0031 441 02A

TVET CDACC UNIT CODE: ENG/CU/WEF/BC/02/5/MA

Relationship with Occupational Standards

This unit addresses the Unit of Competency: Apply Communication Skills

Duration of Unit: 40 Hours

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train communication skills. The learning outcomes involve 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 should be able to:

S/NO	Learning Outcomes	Duration (Hours)
1.	Apply communication channels.	10
2.	Apply written communication skills.	12
3.	Apply non-verbal skills.	4
4.	Apply oral communication skills.	4
5.	Apply group communication skills.	10
Totals		**40**

Learning Outcomes, Content, and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply communication channels	1.1 Communication process 1.2 Principles of effective communication 1.3 Channels/medium/modes of	• Oral questions • Written assessment • Observation • Portfolio of Evidence

Learning Outcome	Content	Suggested Assessment Methods
	communication 1.4 Factors to consider when selecting a channel of communication 1.5 Barriers to effective communication 1.6 Flow/patterns of communication 1.7 Sources of information 1.8 Organizational policies	• Practical assessment • Third party report
2. Apply written communication skills	2.1 Types of written communication 2.2 Elements of communication 2.3 Organization requirements for written communication	• Oral assessment • Written assessment • Observation • Portfolio of Evidence • Practical assessment • Third party report
3. Apply non-verbal communication skills	3.1 Utilize body language and gestures 3.2 Apply body posture 3.3 Apply workplace dressing code	• Oral assessment • Written assessment • Observation • Portfolio of Evidence • Practical assessment • Third party report
4. Apply oral communication skills	4.1 Types of oral communication pathways 4.2 Effective questioning techniques 4.3 Workplace etiquette 4.4 Active listening	• Oral assessment • Written assessment • Observation • Portfolio of Evidence • Practical assessment • Third party report

Learning Outcome	Content	Suggested Assessment Methods
5. Apply group discussion skills	5.1 Establishing rapport 5.1.1 Facilitating resolution of issues 5.1.2 Developing action plans 5.1.3 Group organization techniques 5.1.4 Turn-taking techniques 5.1.5 Conflict resolution techniques 5.1.6 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**			
1.	Textbooks	Comprehensive texts books on Communication Skills	30 pcs	1:1

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
2.	Mobile Phones	Smartphone for use by trainees	30 pcs	1:1
3.	Internet connection	Internet connection to aid communication between trainees		
4.	PowerPoint Presentations	For trainer's use, covering course content and practical applications	1	1:30
5.	Projector	Functional projector for displaying content during presentations	1	1:30
6.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:30
7.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings	1	1:30
8.	Templates	Templates for creating various documents e.g. CV, Cover Letter, minutes, reports etc.	30	1:1
B	**Learning Facilities & Infrastructure**			
1.	Lecture/Theory Room /Learning Resource Area*	Spacious, equipped with projectors and Seats for 30	1	1:30

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
		trainees, approximately 45 sqm (5 m x 9 m)		
2.	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**			
3.	Printing Papers	A4 and A3 Printing papers suitable for the task	Enough	
4.	Flashcards	For carrying out various activities by trainees	Enough	
5.	Flipcharts	Sufficient for group work activities and displaying	Enough	
6.	Whiteboard Marker Pens	Dry-erase markers for trainers use. Assorted colors	Enough	

WORK ETHICS AND PRACTICES

UNIT CODE: 0417 441 03A

TVET CDACC UNIT CODE: ENG/CU/WEF/BC/03/5/MA

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 of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train work ethics and practices. The learning outcomes involve 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 should be able to:

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

Learning Outcomes, Content, and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply self-management skills	1.1 Self-awareness 1.2 Formulating personal vision, mission, and goals 1.3 Healthy lifestyle practices 1.4 Strategies for overcoming work challenges 1.5 Emotional intelligence 1.6 Coping with Work Stress. 1.7 Assertiveness versus aggressiveness and passiveness 1.7.1 Developing and maintaining high self-esteem 1.7.2 Developing and maintaining positive self-image 1.7.3 Time management 1.7.4 Setting performance targets 1.7.5 Monitoring and evaluating performance targets	• Observation • Written assessment • Oral assessment • Third party reports • Portfolio of evidence • Project • Practical
2. Promote ethical work practices and values	2.1 Integrity 2.2 Core Values, ethics and beliefs 2.3 Patriotism 2.4 Professionalism 2.5 Organizational codes of	• Observation • Written assessment • Oral assessment • Third party reports • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	conduct 2.6 Industry policies and procedures	● Project ● Practical
3. Promote Teamwork	3.1 Types of teams 3.2 Team building 3.2.1 Individual responsibilities in a team 3.2.2 Determination of team roles and objectives 3.2.3 Team parameters and relationships 3.2.4 Benefits of teamwork 3.2.5 Qualities of a team player 3.2.6 Leading a team 3.2.7 Team performance and evaluation 3.3 Conflicts and conflict resolution 3.4 Gender and diversity mainstreaming 3.5 Developing Healthy workplace relationships 3.6 Adaptability and flexibility	● Observation ● Written assessment ● Oral assessment ● Third party reports ● Portfolio of evidence ● Project ● Practical

Learning Outcome	Content	Suggested Assessment Methods
	3.7 Coaching and mentoring skills	
4. Maintain professional and personal development	4.1 Personal vs professional development and growth 4.2 Avenues for professional growth 4.3 Recognizing career advancement 4.4 Training and career opportunities 4.4.1 Assessing training needs 4.4.2 Mobilizing training resources 4.5 Licenses and certifications for professional growth and development 4.6 Pursuing personal and organizational goals 4.7 Managing work priorities and commitments 4.8 Dynamism and on-the-job learning	• Observation • Written assessment • Oral assessment • Third party reports • Portfolio of evidence • Project • Practical
5. Apply Problem-solving skills	5.1 Causes of problems 5.2 Methods of solving problems 5.3 Problem-solving process 5.4 Decision making 5.5 Creative thinking and critical	• Observation • Written assessment • Oral assessment • Third party reports • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	thinking process in development of innovative and practical solutions	• Project • Practical
6. Promote Customer Care	6.1 Identifying customer needs 6.2 Qualities of good customer service 6.3 Customer feedback methods 6.4 Resolving customer concerns 6.5 Customer outreach programs 6.6 Customer retention	• Observation • Written assessment • Oral assessment • Third party reports • Portfolio of evidence • Project • Practical

Suggested Methods of Instruction

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

Recommended Resources for 30 Trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Comprehensive texts books on Work Ethics and Practices	30 pcs	1:1

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
2.	PowerPoint Presentations	For trainer's use, covering course content and practical applications	1	1:30
3.	Projector	Functional projector for displaying content during presentations	1	1:30
4.	Media Resources	This include but are not limited to: • Video Clips • Audio Clips • TV Sets • Radio Sets		
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:30
B	**Learning Facilities & Infrastructure**			
6.	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
7.	Computer Laboratory	Equipped with at least 30 functional computers with internet connectivity and the following software:	30	1:1

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
		• Windows/ Linux/ Macintosh Operating System • Microsoft Office Software • Google Workspace Account • Antivirus Software		
C	**Consumable Materials**			
8.	Printing Papers	A4 and A3 Printing papers suitable for the task	Enough	
9.	Flashcards	For carrying out various activities by trainees	Enough	
10.	Charts	Sufficient for group work activities and displaying	Enough	
11.	Whiteboard Marker Pens	Dry-erase markers for trainers use. Assorted colors	Enough	

METALLURGY

Unit Code: 0715 441 09A

TVET CDACC UNIT CODE: ENG/CU/WEF/CC/01/5/MA

Unit Duration: 80 Hours

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Apply Metallurgy

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train metallurgy. The learning outcomes involve analyzing properties of engineering materials, using steel, aluminium, copper and its alloys, titanium and their alloys as well as performing metal testing.

Summary of Learning Outcomes

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

S/NO	Learning Outcomes	Duration (Hours)
1.	Evaluate properties of engineering materials	10
2.	Apply steel and its alloys	20
3.	Apply aluminium and its alloys	20
4.	Apply copper and its alloys	10
5.	Apply titanium and its alloys	10
6.	Perform metal testing	10
Totals		**80**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Evaluate properties of engineering materials	1.1 Occupational health and safety standards 1.1.1 Workplace legislation and standards 1.1.2 Workplace hazard identification 1.1.3 Workshop waste management 1.1.4 Workshop safety 1.1.4.1 Regulations 1.1.4.2 Personal Protective Equipment 1.1.5 Workplace procedures 1.1.5.1 Roles and responsibilities 1.1.5.2 Documentation 1.1.5.3 Communication 1.1.5.4 Emergency procedures 1.1.6 Types of workplace hazards 1.1.6.1 Physical 1.1.6.2 Chemical 1.1.6.3 Biological 1.1.6.4 Environmental 1.1.7 Prevention and control 1.2 Metal properties 1.2.1 Physical 1.2.1.1 Color 1.2.1.2 Lustre	• Written tests • Practical • Projects • Portfolio of Evidence

Learning Outcome	Content	Suggested Assessment Methods
	1.2.1.3 Opacity 1.2.2 Mechanical 1.2.2.1 Strength 1.2.2.2 Hardness 1.2.2.3 Ductility 1.2.2.4 Malleability 1.2.2.5 Toughness 1.2.2.6 Rigidity 1.2.2.7 Elasticity 1.2.2.8 Plasticity 1.2.2.9 Brittleness 1.2.3 Thermal 1.2.3.1 Melting point 1.2.3.2 Specific heat capacity 1.2.3.3 Linear expansivity 1.3 Forms of metal supply 1.3.1 Ingots 1.3.2 Bars 1.3.3 Plates 1.3.4 Pellets 1.3.5 Tubes 1.3.6 Pipes 1.3.7 Sheets 1.3.8 Strips 1.3.9 Wires 1.4 Applications of forms of supply 1.5 Mill Test Certificates	

Learning Outcome	Content	Suggested Assessment Methods
	1.5.1 Interpretation 1.5.2 Usage 1.6 Types of metals 1.6.1 Ferrous 1.6.1.1 Steel 1.6.1.2 Cast Iron 1.6.2 Non ferrous 1.6.2.1 Aluminium 1.6.2.2 Copper 1.6.2.3 Titanium	
2. Apply steel and its alloys	2.1 Steels up to 16 mm thickness 2.1.1 Low carbon steels 2.1.2 Medium carbon steels 2.1.3 High carbon steels 2.1.4 Mild steel 2.2 Properties and applications of steel 2.3 Steel alloys up to 16 mm thickness 2.3.1 Carbon steel alloys (series 10xx, 11xx, 12xx) 2.3.2 Alloy steel alloys (series 13xx, 14xx, 15xx, 16xx, 17xx) 2.3.3 Stainless steel alloys (series 2xxx, 3xxx, 4xxx, 5xxx, 6xxx, 7xxx) 2.3.4 Tool steel alloys (series T, O, W)	• Written tests • Practical • Projects • Portfolio of Evidence

Learning Outcome	Content	Suggested Assessment Methods
	2.4 Properties and applications of alloy steels	
3 Apply aluminium and its alloys	3.1 Aluminium and aluminium alloys up to 16 mm thickness 3.1.1 1000 series (Pure aluminium) 3.1.2 2000 series (Cooper alloy) 3.1.3 3000 series (Manganese alloys) 3.1.4 4000 series (Silicon alloys) 3.1.5 5000 series (Magnesium alloys) 3.1.6 6000 series (Magnesium and silicon alloys) 3.1.7 7000 series (Zinc alloys) 3.1.8 8000 series (Lithium alloys) 3.2 Properties and applications of aluminium and its alloys	• Written tests • Practical • Projects • Portfolio of Evidence
4 Apply copper and its alloys	4.1 Copper and copper alloys up to 16 mm thickness 4.1.1 Copper-Alloy Series (C1xxx - Pure Copper) 4.1.2 Brass Alloys (C2xxx - Copper-Zinc Alloys) 4.1.3 Bronze Alloys (C6xxx - Copper-Tin Alloys) 4.1.4 Copper-Nickel Alloys (C7xxx - Copper-Nickel Alloys)	• Written tests • Practical • Projects • Portfolio of Evidence

Learning Outcome	Content	Suggested Assessment Methods
	4.1.5 Aluminium Bronze Alloys (C8xxx - Copper-Aluminium Alloys) 4.1.6 Copper-Silver Alloys (C1xxx - Copper-Silver Alloys) 4.1.7 Beryllium Copper Alloys (C17200 - Copper-Beryllium Alloys) 4.2 Properties and applications of copper and its alloys	
5 Apply titanium and its alloys	5.1 Titanium and titanium alloys up to 16 mm thickness 5.1.1 Unalloyed Titanium 5.1.2 Alpha Alloys (α) 5.1.3 Beta Alloys (β) 5.1.4 Alpha-Beta Alloys (α-β) 5.1.5 Titanium Alloys by UNS (Unified Numbering System) 5.2 Properties and applications of titanium and its alloys	• Written tests • Practical • Projects • Portfolio of Evidence
6 Perform metal testing	6.1 Metal inspection machines, tools and equipment 6.1.1 Tools 6.1.1.1 Pneumatic tools 6.1.1.2 Gauges 6.1.1.3 Electromagnets 6.1.2 Use and care of tools	• Written tests • Practical • Projects • Portfolio of Evidence

Learning Outcome	Content	Suggested Assessment Methods
	6.1.3 Machines 6.1.3.1 Universal testing machine 6.1.3.2 Ultrasonic testing machine 6.1.3.3 Radiography 6.1.4 Use and care of machines 6.2 Consumables 6.2.1 Films 6.2.2 Ferromagnetic Materials 6.2.3 Dyes 6.3 Non-destructive metal test parameters 6.3.1 Flaws 6.3.2 Pinholes 6.3.3 Penetration 6.3.4 Undercut 6.4 Weld Preparation procedure 6.4.1 Polishing 6.4.2 Grinding 6.4.3 Cleaning 6.4.4 Cutting 6.5 Non-destructive metal test 6.5.1 Visual inspection 6.5.2 Ultrasonic inspection 6.5.3 Magnetic particle induction 6.5.4 Radiography inspection 6.5.5 Dye penetrant	

Learning Outcome	Content	Suggested Assessment Methods
	6.5.6 Eddy current testing 6.6 Applications and procedure of NDT 6.7 Destructive metal test parameters 6.7.1 Tensile strength 6.7.2 Yield strength 6.7.3 Hardness 6.7.4 Impact resistance 6.8 Destructive metal test 6.8.1 Tensile testing 6.8.2 Hardness testing 6.8.3 Impact test (Charpy and Izod) 6.8.4 Fatigue test 6.8.5 Creep test 6.8.6 Torsion test 6.8.7 Bend test 6.8.8 Fracture toughness test 6.8.9 Corrosion test Maintenance 6.8.10 Applications and procedure of DT 6.9 Maintenance 6.9.1 Lubrications 6.9.2 Belt adjustments 6.9.3 Scheduling 6.9.4 Record keeping	

Suggested Delivery Methods

- Demonstration
- Group discussions
- Exercises

- Online materials
- Direct instructions
- Simulation

List of Recommended Resources

Recommended Resources for 30 trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Textbooks on Materials Testing	30	1:1
2.	Drawing papers	A4, A3 and A2 size drawing papers for drafting of sketches and working drawings	1 ream	
3.	Projector	Functional projector for displaying content during presentations	1	1:30
4.	Computer	Functional desktop computer with online instructional content	1	1:30
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:30
6.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings	1	1:30
B	**Learning Facilities & Infrastructure**			
7.	Lecture/Theory Room	Spacious room with seats for 25 trainees, approximately 60 sqm	1	1:30

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
8.	Workshop	Standard workshop with bench/fitting area and welding booths approximately 80 sqm	1	1:30
C	**Materials and Supplies**			
9.	Dust coat/ overall	Shields skin and regular clothes from sparks	30	1:
10.	Gloves	Shields hands from sharp edges, heat, and chemical exposure	30	1:1
11.	Safety boots	Protects feet from heavy objects, sharp materials, and impact.	30	1:1
12.	Ear muffs/ ear plugs	Shields against prolonged exposure to high noise levels from machinery	30	1:1
13.	Safety goggles	Protects eyes from flying metal particles, sparks, and dust	30	1:1
14.	Raw materials	Steel, aluminum, copper and titanium Plates ❑ 4mm thickness. ❑ 6 mm thickness. ❑ 9 mm thickness. ❑ 12 mm thickness. ❑ 16 mm thickness Pipes ❑ 4 mm thickness ❑ 6 mm thickness		

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
		❑ 9 mm thickness ❑ 12 mm thickness ❑ 16 mm thickness Sheets ❑ Below 4mm thickness		
15.	Liquid dyes and developers	For liquid penetrant test	Enough	
16.	First Aid kit	Fully equipped First Aid kit for use in case of accidents	1	1:30
17.	Brooms and cleaning stuff	Hand brooms and mops for cleaning	10	1:3
18.	Cotton waste	Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment		
19.	Cleaning detergents	General degreasers	10 liters	
		Floor detergents	10 liters	
		Hand detergents	10 liters	
D	**Tools and Equipment**			
Measuring tools				
20.	Steel rules	Calibrated steel rules for linear measurements	20	2:3
21.	Vernier calipers	Calibrated vernier calipers for linear measurements	20	2:3
22.	Tri squares	Properly aligned steel Tri-square for checking perpendicular edges	6	1:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
23.	Vernier height gauge and surface plates	Calibrated vernier height gauges and surface plates for measurement of heights	6	1:5
24.	Measuring tapes	Calibrated measuring tapes for linear measurements	20	2:3
25.	Angle gauges	Calibrated steel rules for linear measurements	6	1:5
Marking out tools				
26.	Scribers	Quality steel pencil scribers for marking out lines on metal surfaces	20	2:3
27.	Dot punches	Quality steel dot punches for marking out centres	20	2:3
28.	Calipers	Quality steel calipers for marking out arcs on metal surfaces	6	1:5
Cutting Tools				
29.	Assorted hand files	Flat and round hand files for material preparation and finishing	20	2:3
30.	Hacksaws	Hack saws with functional frames and blades for cutting metal plates and pipes	20	2:3
31.	Tinsnips	Functional hand tinsnips for cutting metal sheets	10	1:3

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
32.	Angle grinders	Portable angle grinders with cutting and grinding disks for cutting and grinding metal plates and pipes	5	1:5
Work holding tools				
33.	Work benches	Stable work benches for carrying out bench work	6	1:5
34.	Bench vices	Functional bench vices/clamps for holding work pieces during bench work	20	2:3
35.	Tongs	Functional pairs of tongs for holding hot pieces of metal during welding	10	1:3
Finishing tools				
36.	Wire brushes	To clean metal surfaces	20	2:3
37.	File cards	Cleaning tool used to maintain files	6	1:5
E	**Machines and Equipment**			
38.	Universal testing machine	Functional machine for carrying out hardness test, tensile test, torsion test	1	1:30
39.	Bend test machine	Functional machine for carrying out bend test	1	1:30
40.	Ultrasonic testing machine	Functional machine for carrying out ultrasonic test	1	1:30
41.	Hardness testing machine	Functional machine for carrying out hardness test	1	1:30

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
42.	X-ray machine	Functional machine for carrying out X-ray test	1	1:30
43.	Firefighting equipment	for ensuring safety in fabrication workshops where fire hazards are present, such as sparks	3	
44.	Rolling machines	used to bend and shape metal sheets into curved shapes, cylinders, or tubes	1	1:30
45.	Bending machine	used to bend metal sheets or bars into angles and specific shapes.	1	1:30
46.	Bench shears		6	1:5
F	**Reference Materials**			
47.	Operation sheets	Operation sheets describing the procedures to be followed in carrying out testing	30	1:1
48.	Training Presentations/Slides	Digital format for shared access among trainees	1	1:30
49.	Practical Assessment Guides	Worksheets for practical assessments	30	1:1

MATHEMATICS

Unit Code: 0541 441 05A

TVET CDACC UNIT CODE: ENG/CU/WEF/CC/02/5/MA

Relationship with Occupational Standards

This unit addresses the Unit of Competency: Apply Mathematics

Unit Duration: 80 Hours

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train mathematics. The learning outcomes involve those required in order to apply algebra, trigonometric functions, coordinate geometry, statistics, vector theorem, matrices and to carry out mensuration.

Summary of Learning Outcomes

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

S/No.	Learning Outcomes	Duration (Hours)
1.	Apply algebra	20
2.	Apply trigonometric functions	20
3.	Carry out mensuration	20
4.	Apply statistics and probability	20
		80

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply algebra	1.1 Indices 1.1.1 Power zero 1.1.2 Negative powers 1.1.3 Fractional powers	• Written tests

	1.1.4 Laws of indices 1.1.4.1 Addition 1.1.4.2 Subtraction 1.1.4.3 Division 1.1.4.4 Multiplication 1.2 BODMAS 1.3 Roots 1.3.1 Square roots 1.3.2 Cube roots 1.3.3 n^{th} roots 1.4 Logarithms 1.4.1 Laws of Logarithms 1.4.1.1 Product Law 1.4.1.2 Quotient Law 1.4.1.3 Power Law 1.5 Use of scientific calculator 1.5.1 Power ON/OFF 1.5.2 Mode 1.5.2.1 Degree 1.5.2.2 Radian 1.5.2.3 Gradient 1.5.2.4 SD 1.5.3 Clear 1.5.4 Save 1.5.5 Shift 1.6 Simultaneous equations (up to 3 equations) 1.6.1 Elimination 1.6.2 Substitution 1.6.3 Reduction	

	1.6.4 Graphical 1.7 Quadratic equations 1.7.1 Factorization 1.7.2 Quadratic formula 1.7.3 Completing the square 1.7.4 Graphical	
2. Apply trigonometric functions	2.1 Angles 2.1.1 Acute 2.1.2 Obtuse 2.1.3 Reflex 2.1.4 Right angle 2.2 Triangles 2.2.1 Isosceles 2.2.2 Equilateral 2.2.3 Right angled 2.2.4 Scalene 2.3 Trigonometric Ratios 2.3.1 Sine 2.3.2 Cosine 2.3.3 Tangent 2.3.4 Cosecant 2.3.5 Secant 2.3.6 Cotangent 2.4 Trigonometric Identities 2.4.1 Proof of identities 2.4.2 Pythagorean identities 2.5 Solve trigonometric equations 2.6 Hyperbolic functions 2.6.1 Sinh x 2.6.2 Cosh x	• Written tests

	2.6.3 Cosech x 2.6.4 Tanh x 2.6.5 Sech x	
3. Carry out mensuration	3.1 Units and symbols of measurement 3.1.1 Mass 3.1.2 Distance 3.1.3 Speed 3.1.4 Temperature 3.1.5 Time 3.2 Imperial and metric units 3.2.1 Conversions 3.3 Perimeter 3.3.1 Regular shapes 3.4 Area 3.4.1 Regular shapes 3.5 Volume 3.5.1 Regular shapes	• Written tests
4. Apply statistics and probability	4.1 Data presentation 4.1.1 Continuous variables 4.1.2 Histogram 4.1.3 Line 4.2 Discrete variable 4.2.1 Bar graph 4.2.2 Pie graph 4.3 Grouped data 4.3.1 Histogram 4.3.2 Bar 4.3.3 Cumulative frequency 4.3.4 ogive 4.4 Ungrouped data	• Written tests

	4.4.1 Line 4.4.2 Cumulative frequency 4.5 Measures of central tendency 4.5.1 Mean 4.5.1.1 Grouped data 4.5.1.2 Ungrouped data 4.5.2 Mode 4.5.2.1 Grouped data 4.5.2.2 Ungrouped data 4.5.3 Medium 4.5.3.1 Grouped data 4.5.3.2 Ungrouped data 4.6 Measures of dispersion 4.6.1 Standard deviation 4.6.1.1 Grouped data 4.6.1.2 Ungrouped data 4.6.2 Variance 4.6.2.1 Grouped data 4.6.2.2 Ungrouped data 4.7 Probability 4.7.1 With replacement 4.7.2 Without replacement 4.8 Probability distribution functions 4.8.1 Binomial distribution 4.8.2 Poisson distribution 4.9 Normal distribution	

- 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**			
1.	Textbooks	Comprehensive textbooks on Engineering Mathematics	30	1:1
2.	Graph books	For graphical representation of solutions	30	1:1
3.	Projector	Functional projector for displaying content during presentations	1	1:30
4.	Computer	Functional desktop computer with online instructional content	1	1:30
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:30
6.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings	1	1:30
B	**Learning Facilities & Infrastructure**			
7.	Lecture/Theory Room	Spacious room with seats for 25 trainees, approximately 60 sqm	1	1:30
C	**Materials and Supplies**			
8.	First Aid kit	Fully equipped First Aid kit for use in case of accidents	1	1:30

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
D	**Tools and Equipment**			
9.	Set of Mathematical instruments	For constructions and measurements	30	1:1
10.	Scientific Calculator	For Calculations	30	1:1
11.	Firefighting extinguishers	Water, carbon dioxide and chemical powder fire extinguishers for fire fighting	1	1:30
E	**Reference Materials**			
12.	Training Presentations/Slides	Digital format for shared access among trainees	1	1:30
13.	Standard Mathematical Tables	For reference on formulae, identities, laws and principles	30	1:1

ARC WELDING PROCESSES II

Unit Code: 0715 451 16A

TVET CDACC UNIT CODE: ENG/CU/WEF/CR/01/5/MA

Unit Duration: 150 Hours

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Perform Arc Welding Processes II

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train MMAW operations. The learning outcomes involve carrying out manual metal arc welding, gouging and maintaining welding machines, tools and equipment.

Summary of Learning Outcomes

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

S/NO	Learning Outcomes	Duration (Hours)
1.	Carry out manual metal arc welding (MMAW)	50
2.	Carry out gouging	50
3.	Maintain welding machines, tools and equipment	20
Totals		**150**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Carry out Manual Metal Arc Welding (MMAW)	1.1 Occupational health and safety standards 1.1.1 Workplace legislation and standards 1.1.2 Risk Assessment	• Practical test • Project work • Portfolio of evidence • Written tests

Learning Outcome	Content	Suggested Assessment Methods
	1.1.3 Workshop Incident/Accident 1.1.3.1 Nature 1.1.3.2 Causes 1.1.3.3 Prevention 1.1.3.4 Report 1.1.4 Workplace ergonomics and work design 1.1.5 Workplace environmental safety 1.1.5.1 Impact of waste and by-products 1.1.5.2 Workshop waste management 1.1.5.2.1 Housekeeping activities 1.1.5.2.2 Sorting 1.1.5.2.3 Disposal 1.1.6 Workshop safety 1.1.6.1 Layout 1.1.7 Workplace procedures 1.1.7.1 Compliance 1.1.7.2 Documentation 1.1.7.3 Communication 1.1.7.4 Emergency procedures 1.2 Working drawing interpretation 1.2.1 Dimensions 1.2.2 Tolerances 1.2.3 Symbols and notations	

Learning Outcome	Content	Suggested Assessment Methods
	1.3 Manual Metal Arc Welding (MMAW) machines/equipment, tools and materials 1.3.1 Machines 1.3.1.1 AC machine 1.3.1.2 DC machine 1.3.1.3 AC/DC machine 1.3.1.4 Diesel generators 1.3.2 Tools 1.3.2.1.1 Driers 1.3.2.1.2 Welding screens 1.3.2.1.3 Fire extinguishers 1.3.2.1.4 Welding jigs and fixtures 1.3.3 Materials 1.3.3.1 Electrodes 1.3.3.1.1 Types 1.3.3.1.2 Coding 1.3.3.1.3 Applications 1.3.3.2 Plates 1.3.3.3 Pipes 1.3.3.4 Tubes 1.3.4 Uses 1.3.5 Care and storage 1.4 MMAW parameters 1.4.1 Current	

Learning Outcome	Content	Suggested Assessment Methods
	1.4.2 Arc length 1.4.3 Arc force 1.4.4 Polarity 1.5 Metals up to 16 mm thickness 1.5.1 Plates 1.5.1.1 Steel 1.5.1.2 Copper 1.5.1.3 Aluminium 1.5.2 Pipes 1.5.2.1 Steel 1.5.2.2 Copper 1.5.2.3 Aluminium 1.6 MMAW material preparation (up to 16 mm thickness) 1.6.1 Measuring 1.6.2 Marking out 1.6.3 Cutting 1.6.4 Edge preparation 1.7 Welding positions 1.7.1 Types 1.7.1.1 Flat 1.7.1.2 Horizontal 1.7.1.3 Vertical 1.7.1.4 Overhead 1.8 Welded joints 1.8.1 Types 1.9 Weld defects 1.9.1 Types	

Learning Outcome	Content	Suggested Assessment Methods
	1.9.1.1 Porosity 1.9.1.2 Undercut 1.9.1.3 Incomplete penetration 1.9.1.4 Slag inclusion 1.9.1.5 Reinforcement 1.9.1.6 Spatters 1.9.1.7 Weld craters 1.9.1.8 Weld cracks 1.9.1.9 Distortion 1.9.2 Causes and prevention 1.10 Arc welded product finishing processes 1.10.1 Types 1.10.1.1 Buffing 1.10.1.2 Polishing 1.10.1.3 Grinding 1.10.1.4 Varnishing 1.10.1.5 Painting 1.10.2 Procedure and applications **Practice** ❑ Arc weld metal plates and pipes of 9-16 mm thickness in: • Flat position • Horizontal position • Vertical position • Overhead position	

Learning Outcome	Content	Suggested Assessment Methods
2. Carry out gouging	1.11 Gouging parameters 1.11.1 Setting parameters 1.11.1.1 Current 1.11.1.2 Arc force 1.12 Electrodes 1.12.1 Graphite electrode selection 1.13 Gouging procedure (up to 16 mm thickness) **Practice** ❑ Arc cut steel, aluminium, copper and titanium plates and pipes of 9-16 mm thickness in: • Flat position • Horizontal position • Vertical position • Overhead position	• Written tests • Practical test • Project work • Portfolio of evidence
3. Maintain welding machines, tools and equipment	a. Repair of welding tools parts i. Handles ii. Heads iii. Jaws iv. Blades v. Discs and wheels 3.2 Preventive maintenance of welding machines and equipment 3.2.1 Cleaning external surfaces of machine	• Written tests • Practical test • Project work • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	3.2.2 Inspecting cables, connectors and power sources 3.2.3 Lubricating moving parts 3.3 Preventive maintenance report 3.3.1 Report preparation 3.3.2 Uses 3.3.3 Storage **Practice** ❑ Clean external surfaces of machine ❑ Inspect cables, connectors and power sources ❑ Lubricate moving parts ❑ Report writing.	

Suggested Delivery Methods

- Demonstration
- Group discussions
- Practical work
- Exercises
- Direct instructions
- Industrial visits/Excursion
- Online materials
- Simulation

List of Recommended Resources

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Textbooks on Manual Metal Arc Welding (MMAW)	25	1:1
2.	Drawing papers	A4, A3 and A2 size drawing papers for drafting of sketches and working drawings	1 ream	
3.	Projector	Functional projector for displaying content during presentations	1	1:25
4.	Computer	Functional desktop computer with online instructional content	1	1:25
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:25
6.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings	1	1:25
B	**Learning Facilities & Infrastructure**			
7.	Lecture/Theory Room	Spacious room with seats for 25 trainees, approximately 60 sqm	1	1:25
8.	Workshop	Standard workshop with bench/fitting area and welding booths approximately 80 sqm	1	1:25

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
C	**Materials and Supplies**			
9.	PPEs	Quality PPE for personal protection during welding and fabrication:		
		Dust coats	25	1:1
		Leather aprons	25	1:1
		Face shield	25	1:1
		Overalls	25	1:1
		Leather gloves	25	1:1
		Safety boots	25	1:1
		Goggles	25	1:1
10.	Raw materials	Steel, aluminum, copper and titanium Plates ❑ 4mm thickness. ❑ 6 mm thickness. ❑ 9 mm thickness. ❑ 12 mm thickness. ❑ 16 mm thickness Pipes ❑ 4 mm thickness ❑ 6 mm thickness ❑ 9 mm thickness ❑ 12 mm thickness ❑ 16 mm thickness		
11.	First Aid kit	Fully equipped First Aid kit for use in case of accidents	1	1:25

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
12.	Brooms and cleaning stuff	Hand brooms and mops for cleaning	10	2:5
13.	Cotton waste	Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment	Enough	
14.	Cleaning detergents	General degreasers	10 litres	
		Floor detergents	10 litres	
		Hand detergents	10 litres	
15.	Electrodes	2.5 mm and 3.2 mm rutile (fill-freeze) electrodes	50 pkts	
D	**Tools and Equipment**			
Measuring tools				
16.	Steel rules	Calibrated steel rules for linear measurements	20	4:5
17.	Vernier calipers	Calibrated vernier calipers for linear measurements	20	4:5
18.	Tri squares	Properly aligned steel Tri-square for checking perpendicular edges	5	1:5
19.	Vernier height gauge and surface plates	Calibrated vernier height gauges and surface plates for measurement of heights	5	1:5
20.	Measuring tapes	Calibrated measuring tapes for linear measurements	20	4:5
21.	Angle gauges	Calibrated steel rules for linear measurements	5	1:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
Marking out tools				
22.	Scribers	Quality steel pencil scribers for marking out lines on metal surfaces	20	4:5
23.	Dot punches	Quality steel dot punches for marking out centres	20	4:5
24.	Calipers	Quality steel calipers for marking out arcs on metal surfaces	5	1:5
Cutting Tools				
25.	Assorted hand files	Flat and round hand files for material preparation and finishing	20	4:5
26.	Hacksaws	Hack saws with functional frames and blades for cutting metal plates and pipes	20	4:5
27.	Angle grinders	Portable angle grinders with cutting and grinding disks for cutting and grinding metal plates and pipes	5	1:5
Work holding tools				
28.	Work benches	Stable work benches for carrying out bench work	5	1:5
29.	Bench vices	Functional bench vices/clamps for holding work pieces during bench work	20	4:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
30.	Tongs	Functional pairs of tongs for holding hot pieces of metal during welding	10	2:5
Finishing tools				
31.	Wire brushes	Steel wire brushes for cleaning metal surfaces and welds	20	4:5
32.	Chipping hammers	Metal chipping hammers for removing spatters and slags from welds	10	2:5
33.	File cards	High grade hardened steel file cards for cutting and smoothing metal edges and surfaces	5	1:5
E	**Machines and Equipment**			
34.	Arc welding machines	DC welding machine	10	2:5
35.	Firefighting extinguishers	Water, carbon dioxide and chemical powder fire extinguishers for fire fighting	1	1:25
36.	Electrode cabinet/oven	Functional electrode oven and cabinet for baking and storage of electrodes	1	1:25
37.	Welding fixtures	Steel welding fixtures/magnets for securing workpieces during welding	10	2:5
F	**Reference Materials**			

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
38.	Working drawings	Technical welding drawings giving the specifications of the welding to be carried out	25	1:1
39.	Operation sheets	Operation sheets describing the procedures to be followed in carrying out welding	25	1:1
40.	Welding Procedure Specifications (WPS)	WPS to guide on the procedure and standards to be used to achieve specific types of welds	25	1:1
41.	Training Presentations/Slides	Digital format for shared access among trainees	1	1:25
42.	Practical Assessment Guides	Worksheets for practical assessments	25 pcs	1:1

FABRICATION PROCESSES II

Unit Code: 0715 451 17A

TVET CDACC UNIT CODE: ENG/CU/WEF/CR/02/5/MA

Unit Duration: 120 Hours

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Carry out Fabrication Processes II

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train fabrication processes. The learning outcomes involve carrying out bench work, sheet metal work and maintaining fabrication tools, machines and equipment

Summary of Learning Outcomes

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

S/NO	Learning Outcomes	Duration (Hours)
1.	Carry out bench work	50
2.	Carry out sheet metal work	50
3.	Maintain fabrication tools, machines and equipment	20
Totals		**120**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Carry out bench work	1.1 Occupational health and safety standards 1.1.1 Workshop legislation and standards 1.1.2 Risk Assessment	• Practical test • Project work • Portfolio of evidence • Written tests

Learning Outcome	Content	Suggested Assessment Methods
	1.1.3 Workshop Incident/Accident reporting 1.1.4 Workshop ergonomics and work design 1.1.5 Workshop safety 1.1.5.1 Layout 1.1.6 Workplace procedures 1.1.6.1 Compliance 1.1.6.2 Documentation 1.1.6.3 Communication 1.1.6.4 Emergency procedures 1.2 Fabrication drawing interpretation 1.2.1 Tolerances 1.2.2 Symbols and notations 1.3 Material preparation (metals up to16 mm thickness) 1.3.1 Measuring 1.3.2 Marking out 1.3.3 Cutting 1.3.4 Edge preparation 1.4 Benchwork operations on metals (0.1-12 mm thickness) 1.4.1 Types 1.4.1.1 Filing 1.4.1.2 Grinding 1.4.1.3 Drilling Operations 1.4.1.3.1 Counter boring 1.4.1.3.2 Counter sinking	

Learning Outcome	Content	Suggested Assessment Methods
	1.4.1.3.3 Spot facing 1.4.1.3.4 Reaming 1.4.1.4 Hand threading procedure 1.4.1.4.1 External threads 1.4.1.4.2 Internal threads 1.5 Fitting and assembly of metal parts up to 16 mm thickness 1.5.1 Types and applications of fasteners 1.5.1.1 Bolts 1.5.1.2 Flanges 1.5.1.3 Straps 1.5.1.4 Hooks 1.5.1.5 Turnbuckles 1.5.1.6 Slings 1.5.1.7 Chains 1.5.1.8 Screws 1.5.1.9 Nuts 1.5.1.10 Riveting 1.5.1.10.1 Methods 1.5.1.10.2 Types 1.5.1.10.3 Joints 1.5.1.10.4 Tools 1.7 Joint functionality and quality 1.8 Securing components using adhesives, welds, and press-fits. **Practice**	

Learning Outcome	Content	Suggested Assessment Methods
	❑ Filing of metal plates and pipes • 9 mm thickness • 12 mm thickness • 16 mm thickness ❑ Grinding of metal plates and pipes • 9 mm thickness • 12 mm thickness • 16 mm thickness ❑ Drilling of metal pates • 9 mm thickness • 12 mm thickness • 16 mm thickness ❑ Reaming and tapping of metal pates • 9 mm thickness • 12 mm thickness • 16 mm thickness ❑ Cutting of metal plates and pipes • 9 mm thickness • 12 mm thickness • 16 mm thickness ❑ Riveting of metal sheets ❑ Fabricate metallic frames, doors and windows	
2 Carry out sheet metal work	2.1 Pattern development 2.1.1 Methods 2.1.1.1 Parallel line method 2.1.1.2 Triangulation	• Practical test • Project work

Learning Outcome	Content	Suggested Assessment Methods
	2.1.1.3 Radial line 2.1.2 Procedure and applications 2.2 Sheet metal products 2.2.1 Types 2.2.1.1 Tanks 2.2.1.2 Gutters 2.2.1.3 Cabinets and boxes 2.2.1.4 Drums 2.2.1.5 Tables and desks 2.2.1.6 Guardings/enclosures 2.2.1.7 Troughs 2.2.2 Development and applications **Practice** ❑ Develop the following sheet metal products: • Tanks • Gutters • Cabinets and boxes • Drums • Tables and desks • Guardings/enclosures • Troughs	• Portfolio of evidence • Written tests
3 Maintain fabrication tools, machines and equipment	1.1 Fabrication tools repair 1.1.1 Handles 1.1.2 Heads 1.1.3 Jaws 1.1.4 Blades	• Practical test • Project work • Portfolio of evidence • Written tests

Learning Outcome	Content	Suggested Assessment Methods
	1.1.5 Discs and wheels 3.2 Preventive maintenance of welding fabrication tools, machines and equipment 1.1.6 Cleaning of the external surfaces of the machine 1.1.7 Inspecting cables, connectors and power sources 1.1.8 Lubricating of moving parts 1.2 Preventive maintenance report **Practice** ❑ Clean external surfaces of machine ❑ Inspect cables, connectors and power sources ❑ Lubricate moving parts ❑ Report writing	

Suggested Delivery Methods

- ❑ Demonstration
- ❑ Group discussions
- ❑ Practical work.
- ❑ Exercises
- ❑ Industrial visits
- ❑ Online materials
- ❑ Direct instructions
- ❑ Simulation

List of Recommended Resources

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Textbooks on Fabrication Processes	25	1:1
2.	Drawing papers	A4, A3 and A2 size drawing papers for drafting of sketches and working drawings	1 ream	
3.	Projector	Functional projector for displaying content during presentations	1	1:25
4.	Computer	Functional desktop computer with online instructional content	1	1:25
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:25
6.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings	1	1:25
B	**Learning Facilities & Infrastructure**			
7.	Lecture/Theory Room	Spacious room with seats for 25 trainees, approximately 60 sqm	1	1:25

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
8.	Workshop	Standard workshop with bench/fitting area and welding booths approximately 80 sqm	1	1:25
C	**Materials and Supplies**			
9.	Dust coat/ overall	Shields skin and regular clothes from sparks	25	1:
10.	Gloves	Shields hands from sharp edges, heat, and chemical exposure	25	1:1
11.	Safety boots	Protects feet from heavy objects, sharp materials, and impact.	25	1:1
12.	Ear muffs/ ear plugs	Shields against prolonged exposure to high noise levels from machinery	25	1:1
13.	Safety goggles	Protects eyes from flying metal particles, sparks, and dust	25	1:1
14.	Raw materials	Steel, aluminum, copper and titanium Plates ❑ 4mm thickness. ❑ 6 mm thickness. ❑ 9 mm thickness. ❑ 12 mm thickness. ❑ 16 mm thickness Pipes ❑ 4 mm thickness ❑ 6 mm thickness		

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
		❑ 9 mm thickness ❑ 12 mm thickness ❑ 16 mm thickness Sheets ❑ Below 4mm thickness		
15.	First Aid kit	Fully equipped First Aid kit for use in case of accidents	1	1:25
16.	Brooms and cleaning stuff	Hand brooms and mops for cleaning	10	2:5
17.	Cotton waste	Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment		
18.	Cleaning detergents	General degreasers	10 liters	
		Floor detergents	10 liters	
		Hand detergents	10 liters	
D	**Tools and Equipment**			
Measuring tools				
19.	Steel rules	Calibrated steel rules for linear measurements	20	4:5
20.	Vernier calipers	Calibrated vernier calipers for linear measurements	20	4:5
21.	Tri squares	Properly aligned steel Tri-square for checking perpendicular edges	5	1:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
22.	Vernier height gauge and surface plates	Calibrated vernier height gauges and surface plates for measurement of heights	5	1:5
23.	Measuring tapes	Calibrated measuring tapes for linear measurements	20	4:5
24.	Angle gauges	Calibrated steel rules for linear measurements	5	1:5
Marking out tools				
25.	Scribers	Quality steel pencil scribers for marking out lines on metal surfaces	20	4:5
26.	Dot punches	Quality steel dot punches for marking out centres	20	4:5
27.	Calipers	Quality steel calipers for marking out arcs on metal surfaces	5	1:5
Cutting Tools				
28.	Assorted hand files	Flat and round hand files for material preparation and finishing	20	4:5
29.	Hacksaws	Hack saws with functional frames and blades for cutting metal plates and pipes	20	4:5
30.	Tinsnips	Functional hand tinsnips for cutting metal sheets	10	2:5
31.	Angle grinders	Portable angle grinders with cutting and grinding disks for	5	1:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
		cutting and grinding metal plates and pipes		
Work holding tools				
32.	Work benches	Stable work benches for carrying out bench work	5	1:5
33.	Bench vices	Functional bench vices/clamps for holding work pieces during bench work	20	4:5
34.	Tongs	Functional pairs of tongs for holding hot pieces of metal during welding	10	2:5
Finishing tools				
35.	Wire brushes	To clean metal surfaces	20	4:5
36.	File cards	Cleaning tool used to maintain files	5	1:5
E	**Machines and Equipment**			
37.	Guillotine machines	Used for cutting large sheets of metal into smaller pieces with precision	1	1:25
38.	Firefighting equipment	for ensuring safety in fabrication workshops where fire hazards are present, such as sparks	3	
39.	Rolling machines	used to bend and shape metal sheets into curved shapes, cylinders, or tubes	1	1:25

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
40.	Bending machine	used to bend metal sheets or bars into angles and specific shapes.	1	1:25
F	**Reference Materials**			
41.	Working drawings	Technical welding drawings giving the specifications of the welding to be carried out	25	1:1
42.	Operation sheets	Operation sheets describing the procedures to be followed in carrying out welding	25	1:1
43.	Welding Procedure Specifications (WPS)	WPS to guide on the procedure and standards to be used to achieve specific types of welds	25	1:1
44.	Training Presentations/Slides	Digital format for shared access among trainees	1	1:25
45.	Practical Assessment Guides	Worksheets for practical assessments	25	1:1

MODULE IV

DIGITAL LITERACY

UNIT CODE: 0611 441 01A

TVET CDACC UNIT CODE: ENG/CU/WEF/BC/01/5/MA

Relationship with Occupational Standards

This unit addresses the Unit of Competency: Apply Digital Literacy

Duration of Unit: 40 Hours

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train digital literacy. The learning outcomes involve 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 should be able to:

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

Learning Outcomes, Content, and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
7. Operate computer devices	1.1 Meaning and importance of	• Observation

Learning Outcome	Content	Suggested Assessment Methods
	digital literacy 1.2 Functions and Uses of Computers 1.3 Classification of computers 1.4 Components of a computer system 1.5 Computer Hardware 1.5.1 The System Unit E.g. Motherboard, CPU, casing 1.5.2 Input Devices e.g. Pointing, keying, scanning, voice/speech recognition, direct data capture devices. 1.5.3 Output Devices e.g. hardcopy output and softcopy output 1.5.4 Storage Devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, Hard Drives, CDs & DVDs, Memory cards, Flash drives	● Written assessment ● Oral assessment ● Practical assessment

Learning Outcome	Content	Suggested Assessment Methods
	1.5.5 Computer Ports e.g. HDMI, DVI, VGA, USB type C etc. 1.6 Classification of computer software 1.7 Operating system functions 1.8 Procedure for turning/off a computer 1.9 Mouse use techniques 1.10 Keyboard Parts and Use Techniques 1.11 Desktop Customization 1.12 File and Files Management using an operating system 1.13 Computer Internet Connection Options 1.13.1 Mobile Networks/Data Plans 1.13.2 Wireless Hotspots 1.13.3 Cabled (Ethernet/Fiber) 1.13.4 Dial-Up 1.13.5 Satellite 1.14 Computer external devices management 1.14.1 Device connections 1.14.2 Device controls	

Learning Outcome	Content	Suggested Assessment Methods
	(volume controls and display properties)	
8. Solve tasks using Office suite	2.1 Meaning and Importance of Word Processing 2.2 Examples of Word Processors 2.3 Working with word documents 2.3.1 Open and close word processor 2.3.2 Create a new document 2.3.3 Save a document 2.3.4 Switch between open documents 2.4 Enhancing productivity 2.4.1 Set basic options/preferences 2.4.2 Help resources 2.4.3 Use magnification/zoom tools 2.4.4 Display, hide built-in tool bar 2.4.5 Using navigation tools 2.5 Typing Text 2.6 Document editing (copy, cut,	● Observation ● Portfolio of Evidence ● Project ● Written assessment ● Practical assessment ● Oral assessment

Learning Outcome	Content	Suggested Assessment Methods
	paste commands, spelling and Grammar check) 2.7 Document formatting 2.7.1 Formatting text 2.7.2 Formatting paragraph 2.7.3 Formatting styles 2.7.4 Alignment 2.7.5 Creating tables 2.7.6 Formatting tables 2.8 Graphical objects 2.8.1 Insert object (picture, drawn object) 2.8.2 Select an object 2.8.3 Edit an object 2.8.4 Format an object 2.9 Document Print setup 2.9.1 Page layout, 2.9.2 Margins set up 2.9.3 Orientation. 2.10 Word Document Printing 2.11 Meaning & Importance of electronic spreadsheets 2.12 Components of Spreadsheets	

Learning Outcome	Content	Suggested Assessment Methods
	2.13 Application areas of spreadsheets 2.14 Using spreadsheet application 2.14.1 Parts of Excel screen: ribbon, formula bar, active cell, name box, column letter,row number, Quick Access Toolbar. 2.14.2 Cell Data Types 2.14.3 Block operations 2.14.4 Arithmetic operators (formula bar (-, +, *, /). 2.14.5 Cell Referencing 2.15 Data Manipulation 2.15.1 Using Functions (Sum, Average, SumIF, Count, Max, Max, IF, Rank, Product, mode etc) 2.15.2 Using Formulae 2.15.3 Sorting data 2.15.4 Filtering data	

Learning Outcome	Content	Suggested Assessment Methods
	2.15.5 Visual representation using charts 2.16 Worksheet printing 2.17 Electronic Presentations 2.18 Meaning and Importance of electronic presentations 2.19 Examples of Presentation Software 2.20 Using the electronic presentation application 2.20.1 Parts of the PowerPoint screen (slide navigation pane, slide pane, notes, the ribbon, quick access toolbar, and scroll bars). 2.20.2 Open and close presentations 2.20.3 Creating Slides (Insert new slides, duplicate, or reuse slides.) 2.20.4 Text Management (insert, delete, copy,	

Learning Outcome	Content	Suggested Assessment Methods
	cut and paste, drag and drop, format, and use spell check). 2.20.5 Use magnification/zoom tools 2.20.6 Apply or change a theme. 2.20.7 Save a presentations 2.20.8 Switch between open presentations 2.21 Developing a presentation 2.21.1 Presentation views 2.21.2 Slides 2.21.3 Master slide 2.22 Text 2.22.1 Editing text 2.22.2 Formatting 2.22.3 Tables 2.23 Charts 2.23.1 Using charts 2.23.2 Organization charts 2.24 Graphical objects 2.24.1 Insert, manipulate	

Learning Outcome	Content	Suggested Assessment Methods
	2.24.2 Drawings 2.25 Prepare outputs 2.25.1 Applying slide effects and transitions 2.25.2 Check and deliver 2.25.2.1 Spell check a presentation 2.25.2.2 Slide orientation 2.25.2.3 Slide shows, navigation 2.26 Print presentations (slides and handouts)	
9. Manage Data and Information	3.1 Meaning of Data and information 3.2 Importance and Uses of data and information 3.3 Types of internet services 3.3.1 Communication Services 3.3.2 Information Retrieval Services 3.3.3 File Transfer 3.3.4 World Wide Web Services	• Observation • Portfolio of Evidence • Project • Written assessment • Practical assessment • Oral assessment

Learning Outcome	Content	Suggested Assessment Methods
	3.3.5 Web Services 3.3.6 Automatic Network Address Configuration 3.3.7 News Group 3.3.8 Ecommerce 3.4 Types of Internet Access Applications 3.5 Web browsing concepts 3.5.1 Key concepts 3.5.2 Security and safety 3.6 Web browsing 3.6.1 Using the web browser 3.6.2 Tools and settings 3.6.3 Clearing Cache and cookies 3.6.4 URIs 3.6.5 Bookmarks 3.6.6 Web outputs 3.7 Web based information 3.7.1 Search 3.7.2 Critical evaluation of information 3.7.3 Copyright, data protection	

Learning Outcome	Content	Suggested Assessment Methods
	3.8 Downloads Management 3.9 Performing Digital Data Backup (Online and Offline) 3.10 Emerging issues in internet	
10. Perform online communication and collaboration	4.1 Netiquette principles 4.2 Communication concepts 4.2.1 Online communities 4.2.2 Communication tools 4.2.3 Email concepts 4.3 Using email 4.3.1 Sending email 4.3.2 Receiving email 4.3.3 Tools and settings 4.3.4 Organizing email 4.4 Digital content copyright and licenses 4.5 Online collaboration tools 4.5.1 Online Storage (Google Drive) 4.5.2 Online productivity applications (Google Docs & Forms) 4.5.3 Online meetings (Google Meet/Zoom) 4.5.4 Online learning environments	• Observation • Portfolio of Evidence • Project • Written assessment • Practical assessment • Oral assessment

Learning Outcome	Content	Suggested Assessment Methods
	4.5.5 Online calendars (Google Calendars) 4.5.6 Social networks (Facebook/Twitter - Settings & Privacy) 4.6 Preparation for online collaboration 4.6.1 Common setup features 4.6.2 Setup 4.7 Mobile collaboration 4.7.1 Key concepts 4.7.2 Using mobile devices 4.7.3 Applications 4.7.4 Synchronization	
11. Apply cybersecurity skills	5.1 Data protection and privacy 5.1.1 Confidentiality of data/information 5.1.2 Integrity of data/information 5.1.3 Availability of data/information 5.2 Internet security threats 5.2.1 Malware attacks 5.2.2 Social engineering attacks	• Observation • Portfolio of Evidence • Project • Written assessment • Practical assessment • Oral assessment

Learning Outcome	Content	Suggested Assessment Methods
	5.2.3 Distributed denial of service (DDoS) 5.2.4 Man-in-the-middle attack (MitM) 5.2.5 Password attacks 5.2.6 IoT Attacks 5.2.7 Phishing Attacks 5.2.8 Ransomware 5.3 Computer threats and crimes 5.4 Cybersecurity control measures 5.4.1 Physical Controls 5.4.2 Technical/Logical Controls (Passwords,PINs, Biometrics) 5.4.3 Operational Controls 5.5 Laws governing protection of ICT in Kenya 5.5.1 The Computer Misuse and Cybercrimes Act No. 5 of 2018 5.5.2 The Data Protection Act No. 24 of 2019	
12. Perform Online Jobs	6.1 Introduction to online working	• Observation

Learning Outcome	Content	Suggested Assessment Methods
	6.2 Types of online Jobs 6.3 Online job platforms 6.3.1 Remotask 6.3.2 Data annotation tech 6.3.3 Cloud worker 6.3.4 Upwork 6.3.5 Oneforma 6.3.6 Appen 6.4 Online account and profile management 6.5 Identifying online jobs/job bidding 6.6 Online digital identity 6.7 Executing online tasks 6.8 Management of online payment accounts.	• Portfolio of Evidence • Project • Written assessment • Practical assessment • Oral assessment
13. Apply job entry techniques	7.1 Types of job opportunities 7.1.1 Self-employment 7.1.2 Service provision 7.1.3 product development 7.1.4 salaried employment 7.1.4.1 Sources of job opportunities	• Observation • Oral assessment • Portfolio of evidence • Third party report • Written assessment

Learning Outcome	Content	Suggested Assessment Methods
	7.2 Resume/ curriculum vitae 7.2.1 What is a CV 7.2.2 How long should a CV be 7.2.3 What to include in a CV 7.2.4 Format of CV 7.2.5 How to write a good CV 7.2.6 Don’ts of writing a CV 7.3 Job application letter 7.3.1 What to include 7.3.2 Addressing a cover letter 7.3.3 Signing off a cover letter 7.4 Portfolio of Evidence 7.4.1 Academic credentials 7.4.2 Letters of commendations 7.4.3 Certification of participations 7.4.4 Awards and decorations 7.5 Interview skills	

Learning Outcome	Content	Suggested Assessment Methods
	7.5.1 Listening skills 7.5.2 Grooming 7.5.3 Language command 7.5.4 Articulation of issues 7.5.5 Body language 7.5.6 Time management 7.5.7 Honesty 7.6 Generally knowledgeable in current affairs and technical area	

Suggested Methods of Instruction

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

Recommended Resources for 30 Trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			

1.	Textbooks	Comprehensive texts books on Digital Literacy	30 pcs	1:1
2.	Installation Manuals	Detailed guides for equipment and software installation and troubleshooting	5 pcs	1:5
3.	PowerPoint Presentations	For trainer's use, covering course content and practical applications	1	1:30
4.	Projector	Functional projector for displaying content during presentations	1	1:30
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:30
6.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings	1	1:30
7.	Templates	Templates for creating various documents e.g. CV, Cover Letter, etc.	30	1:1
B	**Learning Facilities & Infrastructure**			
8.	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
9.	Computer Laboratory	Equipped with at least 30 functional computers with	30	1:1

		internet connectivity and the following software: • Windows/ Linux/ Macintosh Operating System • Microsoft Office Software • Google Workspace Account • Antivirus Software		
C	**Consumable Materials**			
10.	Printing Papers	A4 and A3 Printing papers suitable for the task	Enough	
11.	Whiteboard Marker Pens	Dry-erase markers for trainers use. Assorted colors	Enough	
12.	Storage devices	Any of the following storage devices: • USB Flash Drive • USB Hard Drive • Compact Disks (CDs) • Digital Versatile Disks (DVDs)	Enough	

ENTREPRENEURIAL SKILLS

UNIT CODE: 0413 441 04A

TVET CDACC UNIT CODE: ENG/CU/WEF/BC/04/5/MA

Relationship with occupational standards

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

Duration of unit: 40 Hours

Unit Description:

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train entrepreneurial skills. The learning outcomes involve 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 should be able to:

S/NO	Learning Outcomes	Duration (Hours)
1.	Apply financial literacy	6
2.	Apply the entrepreneurial concept	4
3.	Identify entrepreneurship opportunities	6
4.	Apply business legal aspects	6
5.	Innovate Business Strategies	6
6.	Develop business plan	12
Totals		**40**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply financial literacy	1.1 Personal finance management 1.2 Balancing between needs and wants 1.3 Budget Preparation 1.4 Saving management 1.5 Factors to consider when deciding where to save 1.6 Debt management 1.7 Factors to consider before taking a loan 1.8 Investment decisions 1.9 Types of investments 1.10 Factors to consider when investing money 1.11 Insurance services 1.12 insurance products available in the market 1.13 Insurable risks	• Observation • Project • Written assessment • Oral assessment • Third party report • Interviews
2. Apply entrepreneurial concept	2.1 Difference between Entrepreneurs and Business persons 2.2 Types of entrepreneurs 2.3 Ways of becoming an entrepreneur 2.4 Characteristics of Entrepreneurs	• Observation • Project • Written assessment • Oral assessment • Third party report

Learning Outcome	Content	Suggested Assessment Methods
	2.5 salaried employment and self-employment 2.6 Requirements for entry into self-employment 2.7 Roles of an Entrepreneur in an enterprise 2.8 Contributions of Entrepreneurship	
3. Identify entrepreneurship opportunities	3.1 Sources of business ideas 3.2 Factors to consider when evaluating business opportunity 3.3 Business life cycle	• Observation • Project • Written assessment • Oral assessment • Third party report
4. Apply business legal aspects	4.1 Forms of business ownership 4.2 Business registration and licensing processing 4.3 Types of contracts and agreements 4.4 Employment laws 4.5 Taxation laws	• Observation • Project • Written assessment • Oral assessment • Third party report
5. Innovate business Strategies	5.1 Creativity in business 5.2 Innovative business strategies 5.3 Entrepreneurial Linkages 5.4 ICT in business growth and development	• Observation • Project • Written assessment • Oral assessment • Third party report
6. Develop Business Plan	6.1 Business description	• Observation

Learning Outcome	Content	Suggested Assessment Methods
	6.2 Marketing plan 6.3 Organizational/Management 6.4 plan 6.5 Production/operation plan 6.6 Financial plan 6.7 Executive summary 6.8 Business plan presentation 6.9 Business idea incubation	• Written assessment • Project • Oral assessment • Third party report

Suggested Methods of Instruction

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

Recommended Resources for 30 Trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
1.	Textbooks	Comprehensive texts books on Entrepreneurial Skills	30 pcs	1:1
2.	PowerPoint Presentations	For trainer's use, covering course content and practical applications	1	1:30
3.	Projector	Functional projector for displaying content during presentations	1	1:30
4.	Media Resources	These include but are not limited to: • Video Clips • Audio Clips • TV Sets • Radio Sets • Newspapers • Business Journals • Case studies		
5.	Templates	Templates for creating various documents e.g. business plan, invoices etc.	30	1:1
6.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:30
B	**Learning Facilities & Infrastructure**			
7.	Lecture/Theory Room /Learning Resource	Spacious, equipped with projectors and Seats for 30	1	1:30

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
	Area*	trainees, approximately 45 sqm (5 m x 9 m)		
8.	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**			
9.	Writing Materials	Writing materials for note taking	Enough	
10.	Flashcards	For carrying out various activities by trainees	Enough	
11.	Charts	Sufficient for group work activities and displaying	Enough	
12.	Whiteboard Marker Pens	Dry-erase markers for trainers use. Assorted colors	Enough	

TECHNICAL DRAWING

UNIT CODE: 0732 441 06A

TVET CDACC UNIT CODE: ENG/CU/WEF/BC/03/5/MA

Relationship to Occupational Standards
This unit addresses the unit of competency: Apply technical drawing

Duration of Unit: 80 hours

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

Summary of Learning Outcomes

S/NO	Learning Outcomes	Duration (Hours)
1.	Use technical drawing tools, equipment and materials	10
2.	Produce plane geometry drawings	10
3.	Produce orthographic drawings of components	20
4.	Produce solid geometry drawings	10
5.	Produce Isometric drawings	20
6.	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	1.1.Drawing equipment 1.1.1. T square 1.1.2. Set square 1.1.3. Protractor	• Practical Tests • Written tests

Learning Outcome	Content	Suggested Assessment Methods
	1.1.4. Engineering drawing set 1.2.Drawing materials 1.2.1. Drawing papers 1.2.2. Maskin tape 1.2.3. Clips 1.2.4. Drawing board 1.2.5. Clutch pencils 1.3.Use and maintenance of drawing equipment	
2. Produce plane geometry drawings	2.1 Types of lines in drawings 2.1.1 Boarder lines 2.1.2 Faint continuous lines 2.1.3 Broken lines 2.1.4 Chain lines 2.1.5 Centre lines 2.1.6 Cutting lines 2.2 Construction of angles 2.2.1 Acute angles 2.2.2 Right angles 2.2.3 Reflex angles 2.2.4 Obtuse angles 2.2.5 Straight angles 2.3 Bisection of angles 2.3.1 Acute angles 2.3.2 Right angles 2.3.3 Reflex angles 2.3.4 Obtuse angles	• Practical tests • Written Tests

Learning Outcome	Content	Suggested Assessment Methods
	2.4 Measurement of angles 2.4.1 Acute angles 2.4.2 Right angles 2.4.3 Reflex angles 2.4.4 Obtuse angles 2.4.5 Straight angles 2.5 Construction of plane geometric forms 2.5.1 Triangles 2.5.2 Quadrilaterals 2.5.3 Polygons 2.5.4 Circles and tangents 2.6 Construction of scales 2.6.1 Plane scales 2.6.2 Diagonal scale 2.6.3 Reducing and enlargement scales	
3. Produce orthographic drawings of components	3.1 Orthographic drawings 3.1.1 First angle projection 3.1.2 Third angle projection 3.2 Dimensioning 3.3 Sectional views 3.4 Free hand sketches 3.4.1 Geometric forms 3.4.2 Tools 3.4.3 Equipment 3.4.4 Mechanical components	• Practical tests • Written Tests

Learning Outcome	Content	Suggested Assessment Methods
4. Produce solid geometry drawings	4.1 Sketches and drawings of patterns 4.1.1 Cylinders 4.1.2 Prisms 4.1.3 pyramids 4.2 solids drawings 4.2.1 Prisms 4.2.2 Cones 4.2.3 Cylinders 4.3 Development and interpenetrations of solids 4.3.1 cylinder to cylinder 4.3.2 cylinder to prisms 4.3.3 prism to prism 4.4 Different symbols and abbreviations 4.5 Auxiliary views and true shapes of truncated solids 4.5.1 Truncated cylinder 4.5.2 Truncated prism 4.5.3 Truncated pyramid	• Practical tests • Written Tests
5. Produce isometric drawings	5.1 Isometric sketches and drawings of components 5.2 Isometric curves and circles 5.3 Oblique sketches of components	• Practical tests • Written Tests
6. Produce assembly drawings	6.1 Orthographic views of assembly drawings 6.1.1 First angle projection	• Practical tests • Written Tests

Learning Outcome	Content	Suggested Assessment Methods
	6.1.2 Third angle projection 6.2 Sectional views 6.3 Parts list	

Suggested Methods of Delivery

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

Recommended Resources for 30 trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	Learning Materials			
1.	Textbooks	Comprehensive texts books on Technical Drawing	25 pcs	1:1
2.	PowerPoint Presentations	For trainer's use, covering course content and practical applications	1	1:25
3.	Working drawings	Working drawings giving a detailed overview of the task at hand		
4.	Projector	Functional projector for displaying content during presentations	1	1:25
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:25
B	Learning Facilities & Infrastructure			
6.	Drawing Room /Learning Resource Area*	Spacious, equipped with a projector and drawing tables for 25 trainees, approximately 45 sqm (5 m x 9 m)	1	1:25
C	Consumable Materials			

7.	Drawing papers	A4, A3 and A2 size drawing papers for drafting of sketches and working drawings	1 ream	1:25
8.	Drawing Pencils	For drawing • HB • 2H/3H • 2B	Enough	
9.	Eraser	Dustless eraser for pencil stains	30	
10.	Masking Tape	For attaching the drawing paper to the drawing board	Enough	
D	Tools and Equipment			
11.	Drawing Instruments	The include: • T-squares • 30-60 degree set squares • 45 degree set square • Protractor • Compass set	25 sets	1:1
12.	Pencil Sharpener	For creating sharp pencil tips	25 pcs	1:1
13.	Drawing Tables	For drawing	25 pcs	1:1
E	Reference Materials			
14.	Welding /blueprint /drawing Standards	Reference on industry standards (e.g., BS/ANSI/AWS etc)	5 pcs	1:5
15.	Multimedia Learning Modules	Videos and tutorials	25 pcs	1:1

MECHANICAL SCIENCE

UNIT CODE: 0715 441 07A

TVET CDACC UNIT CODE: ENG/CU/WEF/CC/04/5/MA

Relationship with Occupational Standards: Apply Mechanical Science

Duration of Unit: 80 Hours

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train mechanical science. The learning outcomes involve resolving forces, determining effects of loads in mechanical systems, analysing properties of materials, determining the nature of friction in mechanical systems and solving problems related to motion.

Summary of Learning Outcomes

S/NO	Learning Outcomes	Duration (Hours)
1.	Resolve forces	10
2.	Determine effects of loads in mechanical systems.	**20**
3.	Analyze properties of materials.	**10**
4.	Determine the nature of friction in mechanical systems	**20**
5.	Solve problems related to motion	**20**
Total		**80**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Resolve forces	1.1 Definition of force 1.2 Types of force systems 1.2.1 Collinear	• Written Tests • Portfolio of Evidence

Learning Outcome	Content	Suggested Assessment Methods
	1.2.2 Coplanar 1.2.3 Concurrent 1.3 Theorems of forces 1.3.1 Triangle 1.3.2 Parallelogram 1.3.3 Polygon 1.4 Resolution of forces 1.4.1 Analysis 1.4.2 Graphical Method	
2. Determine effects of loads in mechanical systems.	2.1 Types of Forces 2.1.1 Friction 2.1.2 Centrifugal 2.1.3 Centripetal 2.1.4 Gravitational 2.1.5 Inertia 2.2 Moments 2.2.1 Definition 2.2.2 Calculations of moment of force about an axis 2.3 Principles of Moments 2.3.1 Clockwise and anticlockwise moments 2.4 Application of Moments of Forces in Engineering 2.4.1 Simply supported beams having point loads 2.5 Determination of moment couples	• Written Tests • Portfolio of Evidence

Learning Outcome	Content	Suggested Assessment Methods
	2.5.1 Simply supported beams with couples	
3 Analyze properties of materials	3.1 Mechanical Properties of Materials: 3.1.2 Strength (Compressive, Shear. And Tensile) 3.1.3 Brittleness 3.1.4 Hardness 3.1.5 Malleability 3.1.6 Plasticity 3.1.7 Elasticity 3.1.8 Toughness 3.2 Mechanical Materials Properties Tests 3.2.1 Tensile Test 3.2.2 Hardness Test 3.3 Direct Stresses 3.3.1 Define Stress 3.3.2 Types of Stress: 3.3.2.1 Tensile stress 3.3.2.2 Compressive stress 3.3.3 Calculate Stress 3.4 Selection of Materials 3.4.1 Factors to Consider in Materials Selection	• Written Tests • Portfolio of Evidence
4 Determine the nature of friction in mechanical systems	4.1 Friction 4.1.2 Definition 4.1.3 Advantages and disadvantages of friction	• Written Tests • Portfolio of Evidence

Learning Outcome	Content	Suggested Assessment Methods
	4.2 Laws of Friction: 4.2.2 Laws of static friction 4.2.3 Laws of dynamic friction 4.3 Effects of Friction 4.4 Applications of Friction 4.4.2 Lubrication 4.4.3 Tyre Traction 4.4.4 Braking Systems 4.4.5 Bearing and Bushings 4.4.6 Grinding of Tools 4.4.7 Transmission Systems	
5 Solve problems related to motion.	5.1 Definition of terms 5.1.2 Distance 5.1.3 Displacement 5.1.4 Time 5.1.5 Speed 5.1.6 Velocity 5.1.7 Acceleration 5.2 Laws of Motion 5.2.2 Newton's First Law of Motion 5.2.3 Newton's Second Law of Motion 5.2.4 Newton's Third Law of Motion 5.3 Calculating Parameters of Motion 5.3.2 Equations of linear and angular motion 5.3.3 Calculations 5.3.3.1 Displacement	• Written Tests • Portfolio of Evidence

Learning Outcome	Content	Suggested Assessment Methods
	5.3.3.2 Speed 5.3.3.3 Velocity 5.3.3.4 Acceleration 5.4 Linear and Angular Motion 5.4.2 Converting 5.4.2.1 Angular to Linear Motion 5.4.2.2 Linear to angular motion 5.5 Motion Graphs 5.5.2 Displacement/Time Graphs 5.5.3 Velocity/Time Graphs	

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**			
1.	Textbooks	Comprehensive textbooks on Engineering Mathematics	30	1:1
2.	Graph books	For graphical representation of solutions	30	1:1
3.	Projector	Functional projector for displaying content during presentations	1	1:30

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
4.	Computer	Functional desktop computer with online instructional content	1	1:30
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:30
6.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings	1	1:30
B	**Learning Facilities & Infrastructure**			
7.	Lecture/Theory Room	Spacious room with seats for 25 trainees, approximately 60 sqm	1	1:30
C	**Materials and Supplies**			
8.	First Aid kit	Fully equipped First Aid kit for use in case of accidents	1	1:30
D	**Tools and Equipment**			
9.	Set of Mathematical instruments	For constructions and measurements	30	1:1
10.	Scientific Calculator	For Calculations	30	1:1
E	**Reference Materials**			
11.	Training Presentations/Slides	Digital format for shared access among trainees	1	1:30
12.	Standard Mathematical Tables	For reference on formulae, identities, laws and principles	30	1:1

ELECTRICAL AND ELECTRONICS PRINCIPLES

UNIT CODE: 0713 441 08A

TVET CDACC UNIT CODE: ENG/CU/WEF/CC/05/5/MA

Relationship with Occupational Standards

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

Unit Duration: 80 Hours

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train electrical and electronics principles. The learning outcomes involve 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 the unit of learning, the trainee will be able to;

S/NO	Learning Outcomes	Duration (Hours)
1.	Apply basic concepts of electrical quantities	10
2.	Apply DC and AC circuits	10
3.	Apply the concept of cells and batteries	10
4.	Apply magnetism and electromagnetism	10
5.	Apply basic electrical machines	20
6.	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	1.1 Basic SI Units 1.1.1 Overview of SI Units	• Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	1.1.1.1 Power (Watts, W) 1.1.1.2 Current (Amperes, A) 1.1.1.3 Resistance (Ohms, Ω) 1.1.1.4 Voltage (Volts, V) 1.2 Conductors and Insulators 1.2.1 Identification and Characteristics 1.2.1.1 Metals vs. non-metals 1.2.1.2 Applications in electrical circuits 1.3 Electrical Quantities 1.3.1 Charge, Force, Work, and Power 1.3.2 Definitions and units 1.3.3 Calculations involving Electrical quantities 1.4 Ohm's Law 1.4.1 Understanding Ohm's Law 1.4.2 Practical applications and calculations 1.5 Basic Electrical and Electronic Measurements 1.5.1 Measurement Techniques 1.5.2 Use of Multimeters, oscilloscopes, and ammeters	• Practical test • Third party report • Written tests • Project work

Learning Outcome	Content	Suggested Assessment Methods
	1.5.3 Measurement accuracy and calibration	
2. Apply DC and AC circuits	2.1 Introduction to Electrical Circuits 2.1.1 Introduction to electricity: 2.1.2 Voltage, current, and power. 2.1.3 Overview of DC and AC circuits. 2.1.4 Basic circuit elements: Resistors, capacitors, and inductors. 2.2 DC Circuit Analysis 2.2.1 Series and parallel circuits. 2.2.2 Voltage and current division principles. 2.2.3 Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL). 2.2.4 Analysis of complex circuits using KVL and KCL. 2.2.5 Hands-on lab: Building and testing DC circuits. 2.3 AC circuits analysis 2.3.1 Introduction to AC: Sinusoidal waveforms, frequency, and period.	• Oral questioning • Portfolio of evidence • Practical test • Third party report • Written tests • Project work

Learning Outcome	Content	Suggested Assessment Methods
	2.3.2 RMS values, peak values, and average values. 2.3.3 AC voltage and current sources. 2.3.4 Phasor representation of AC quantities. 2.3.5 Impedance and admittance. 2.3.6 Series and parallel AC circuits. 2.3.7 Resonance in RLC circuits. 2.3.8 Practical analysis of AC circuits using phasors. 2.3.9 Power in AC Circuits 2.3.9.1 Power factor and power factor correction. 2.3.9.2 Real, reactive, and apparent power. 2.3.9.3 AC power calculations for single-phase and three-phase circuits. 2.3.9.4 Energy consumption and efficiency. 2.3.9.5 Applications of AC power in household and	

Learning Outcome	Content	Suggested Assessment Methods
	industrial settings. 2.4 Practical Activity: 2.4.1 Connection in series and Parallel Simulation	
3. Apply the concept of cells and batteries	3.1 Introduction to Cells and Batteries 3.2 Overview of energy storage and electrochemical cells. 3.3 Basic concepts: Voltage, current, capacity, and energy density. 3.4 e.m.f and internal resistance of cells 3.5 Electrochemical principles: Redox reactions and electrode potentials. 3.6 Components of a cell: Anode, cathode, electrolyte, and separator. 3.7 Types of cells: Primary vs. secondary cells (non-rechargeable vs. rechargeable). 3.8 Primary Cells (Non-Rechargeable) 3.8.1 Zinc-Carbon Cells: Construction, chemistry, and applications. 3.8.2 Alkaline Cells: Advantages over zinc-carbon, usage, and performance characteristics. 3.8.3 Comparison of common primary	• Portfolio of evidence • Practical test • Third party report • Written tests • Project work

Learning Outcome	Content	Suggested Assessment Methods
	cells (e.g., lithium primary cells). 3.8.4 Performance limitations and efficiency of primary cells. 3.8.5 Environmental impact and disposal considerations for non-rechargeable batteries. 3.8.6 Hands-on lab: Testing the performance of different primary cells. 3.9 Secondary Cells (Rechargeable) 3.9.1 Lead-Acid Batteries: Chemistry, construction, and applications (e.g., automotive). 3.9.2 Nickel-Cadmium (NiCd) and Nickel-Metal Hydride (NiMH): Differences, pros, and cons. 3.9.3 Charging and discharging cycles of rechargeable cells. 3.9.4 Lithium-Ion Batteries: Working principles,	

Learning Outcome	Content	Suggested Assessment Methods
	construction, and applications. 3.9.5 Advantages of lithium-ion technology over older battery types. 3.9.6 Safety considerations: Overcharging, thermal runaway, and battery management systems. 3.9.7 Emerging Technologies: Solid-state batteries, lithium-sulphur, and other advancements. 3.9.8 Energy density and power density considerations in modern applications. 3.9.9 Batteries maintenance 3.9.10 Hands-on lab: Disassembling and examining a rechargeable battery. 3.10 Battery Performance and Characteristics 3.10.1 Battery capacity: Ampere-hour (Ah) ratings and energy content.	

Learning Outcome	Content	Suggested Assessment Methods
	3.10.2 Factors affecting battery life: Temperature, charge/discharge rates, and cycling. 3.10.3 Internal resistance and its effect on performance. 3.10.4 Battery efficiency and energy losses. 3.10.5 State of charge (SOC) and depth of discharge (DOD). 3.10.6 Battery degradation and aging mechanisms. 3.10.7 Measuring battery parameters (voltage, current, capacity). 3.10.8 Testing techniques for battery health and performance. 3.10.9 Hands-on lab: Performance testing of different battery types. 3.11 Applications of Batteries 3.11.1 Batteries in consumer electronics (e.g., smartphones, laptops). 3.11.2 Automotive applications: Starting, lighting, and ignition (SLI) batteries.	

Learning Outcome	Content	Suggested Assessment Methods
	3.11.3 Electric vehicles (EVs) and hybrid electric vehicles (HEVs): Battery requirements and challenges. 3.11.4 Industrial and grid storage applications. 3.11.5 Renewable energy integration: Solar and wind energy storage solutions. 3.11.6 Specialized applications: Medical devices, aerospace, and military. 3.11.7 Case studies on battery failure and safety incidents. 3.11.8 Discussion on regulations and standards for battery use. 3.12 Environmental Impact and Recycling 3.12.1 Environmental impact of battery production and disposal. 3.12.2 Strategies for reducing the ecological footprint of battery technologies.	

Learning Outcome	Content	Suggested Assessment Methods
	3.12.3 Recycling processes for different types of batteries. 3.12.4 Government policies and regulations regarding battery disposal. 3.12.5 Advances in battery recycling technologies. 3.13 Hands-on lab: Exploring the recycling process and evaluating eco-friendly battery alternatives.	
4. Apply magnetism and electromagnetism	4.1 Magnetic Circuits and Devices 4.1.1 Introduction to magnetic circuits. 4.1.2 Magnetic flux, magnetic field density, magnetic field strength, Reluctance, magnetomotive force (MMF), and magnetic flux. 4.1.3 Calculations involving magnetic circuits 4.1.4 Analogies between electric and magnetic circuits. 4.1.5 Magnetic materials in electrical devices (soft and hard magnetic materials). 4.2 Electromagnetic Induction	• Oral questioning • Portfolio of evidence • Practical test • Third party report • Written tests • Project work

Learning Outcome	Content	Suggested Assessment Methods
	4.2.1 Faraday's Law of electromagnetic induction. 4.2.2 Lenz's Law: Direction of induced EMF. 4.2.3 Practical applications: Electric generators and transformers. 4.2.4 Induced EMF in different configurations (moving conductors, changing magnetic fields). 4.2.5 Self-induction and mutual induction. 4.2.6 Transformers: Working principles, construction, and applications. 4.2.7 Step up and step-down transformers 4.2.8 Power losses in transformers. 4.2.9 Calculations involving transformers 4.2.10 Energy stored in magnetic fields.	
5. Apply basic electrical machines	5.1 DC Machines 5.1.1 DC machine construction and types (motors and generators). 5.1.2 Working principle of DC generators and back EMF.	• Portfolio of evidence • Practical test • Third party report • Written tests • Project work

Learning Outcome	Content	Suggested Assessment Methods
	5.1.3 Types of DC generators: Series, shunt, and compound. 5.1.4 Working principle of DC motors. 5.1.5 Types of DC motors: Series, shunt, and compound. 5.1.6 Speed-torque characteristics of DC motors. 5.1.7 Performance analysis and efficiency of DC machines. 5.1.8 Starting methods for DC motors. 5.1.9 Hands-on lab: Testing and operating a DC motor/generator. 5.2 Induction Motors (AC Machines) 5.2.1 Introduction to induction motors: Construction and working principles. 5.2.2 Types of induction motors: Squirrel cage and wound rotor. 5.2.3 Rotating magnetic fields and slip in induction motors.	

Learning Outcome	Content	Suggested Assessment Methods
	5.2.4 Equivalent circuit model of an induction motor. 5.2.5 Torque-speed characteristics. 5.2.6 Methods of starting and speed control. 5.2.7 Performance analysis of induction motors. 5.2.8 Losses and efficiency considerations. 5.3 Hands-on lab: Testing and operating an induction motor.	
6. Apply electronics components	Introduction to Electronic Components 1.1.1 Overview of electronics: What are electronic components? 1.1.2 Classification of components: Passive, active, and electromechanical. 1.1.3 Introduction to circuit symbols and schematic diagrams. 1.1.4 Basic electrical quantities and units (voltage, current, resistance). 1.1.5 Understanding datasheets and component specifications.	• Portfolio of evidence • Practical test • Third party report • Written tests • Project work

Learning Outcome	Content	Suggested Assessment Methods
	1.1.6 Overview of testing and measurement tools (multimeters, oscilloscopes). 2 Passive Components 1.2.1 Resistors: Types, color codes, power ratings, and applications. 1.2.2 Capacitors: Types (ceramic, electrolytic, film), capacitance value, and working voltage. 1.2.3 Charging and discharging of capacitors in DC circuits. 1.2.4 Applications of capacitors in filtering, timing, and energy storage. 1.2.5 Inductors: Types, inductance value, and applications. 1.2.6 Inductor behavior in DC and AC circuits. 1.2.7 Introduction to filters: RC, RL, and RLC circuits. 3 Semiconductor Devices 1.3.1 Diodes: Introduction to PN junctions, characteristics, and types (LEDs, Zener diodes, Schottky diodes). 1.3.2 Applications of diodes in rectification, voltage regulation, and signal clipping.	

Learning Outcome	Content	Suggested Assessment Methods
	1.3.3 Transistors: Types (BJT and MOSFET), characteristics, and configurations. 1.3.4 Basic transistor circuits: Switches and amplifiers. 1.3.5 Hands-on lab: Building and testing simple diode and transistor circuits. 1.3.6 Special semiconductor devices: Thyristors, TRIACs, and optoelectronic devices. 1.3.7 Characteristics and applications in switching and control. 4 Integrated Circuits (ICs) 1.4.1 Overview of integrated circuits: Analog vs. digital ICs. 1.4.2 Operational amplifiers (Op-Amps): Characteristics and basic configurations. 1.4.3 Applications of Op-Amps in signal processing. 1.4.4 Timers and oscillators: 555 timer IC and its applications. 1.4.5 Voltage regulators: Linear and switching regulators. 1.4.6 Introduction to data converters (ADC and DAC).	

Learning Outcome	Content	Suggested Assessment Methods
	1.4.7 Digital ICs: Logic gates and flip-flops. 1.4.8 Applications of digital ICs in basic logic circuits. 1.4.9 Hands-on lab: Building circuits using Op-Amps, timers, and logic gates. 5 Electromechanical and Specialized Components 1.5.1 Relays: Types, operation, and applications in switching. 1.5.2 Switches and connectors: Types and usage in electronic circuits. 1.5.3 Transformers: Basic operation, step-up/step-down functions, and isolation. 1.5.4 Displays: LED, LCD, and seven-segment displays. 1.5.5 Circuit Design and Practical Applications 1.5.6 Basic circuit design principles: Bread boarding, PCB layout, and soldering. 1.5.7 Introduction to circuit simulation tools (e.g., Multisim, LTSpice). 1.5.8 Testing and troubleshooting techniques.	

Learning Outcome	Content	Suggested Assessment Methods
	1.5.9 Real-world applications of electronic components. 1.5.10 Building practical projects: Power supplies, audio amplifiers, and sensor-based circuits. 1.5.11 Hands-on lab: Final project assembly and testing.	

Suggested Methods of Instruction

- Demonstration by trainer
- Practice by the trainee
- 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.	6 pcs	1:5
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**			

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
4.	Lecture/Theory Room	Equipped with projectors and seating for 25 trainees, ~60 sqm	1	1:30
5.	Workshop	Hands-on training area with workbenches, tools, and safety equipment, ~80 sqm	1	1:30
6.	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**			
7.	Electrical Wires	Assorted sizes and color-coded (e.g., 1.5mm², 2.5mm², 4mm²)	6 rolls	1:5
8.	Insulation Tapes	For securing connections and insulation, assorted colors	30 pcs	1:1
9.	Breadboard	For prototyping and testing circuits	6 pcs	1:5
10.	Sensors	Assorted types (temperature, pressure, proximity)	10 pcs	1:3
11.	Signal generators	For generating AC signals	6 pcs	1:5
12.	Transducers	Assorted	10 pcs	1:3
13.	Electronic components	Resistors, transistors, capacitors, relays, transformers. Integrated IC, OPAM.	120 pcs	4:1
D	**Tools and Equipment**			

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
14.	Screwdrivers	Assorted sets for various applications	3 sets	1:10
15.	Side Cutters	For cutting wires and cables	6 pcs	1:5
16.	Pliers	For gripping and bending wires	3 pcs	1:10
17.	Stripping Knives	For stripping insulation from wires	5 pcs	1:6
18.	Computers	Equipped with electrical and electronics simulation software	6 pcs	1:5
19.	Multimeters	For measuring voltage, current, and resistance	6 pcs	1:5
20.	Clamp Meters	For measuring current flow in circuits	6 pcs	1:5
21.	Oscilloscope	For observing waveforms and signals	1	1:30
22.	Voltmeter	For measuring voltage	1	1:30
23.	Ammeter	For measuring current	1	1:30
24.	Signal Generator	For generating electrical signals for testing	1	1:30
25.	Soldering gun	For soldering	10	1:3
26.	Soldering wire	For making joints in electrical circuits	10	1:3
27.	PLC	For program practice	6	1:5
28.	Cells and batteries	For learning	6	1:5
E	**PPE (Personal Protective Equipment)**			
29.	PPE Sets	Includes helmets, gloves, safety goggles, shoes, and harnesses	30 sets	1:1

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
30.	Safety Signs and Barriers	For simulating safety zones and hazards	10 sets	1:3
31.	Earthing Test Kits	For ground testing and demonstrating earthing procedures	6 pcs	1:5
32.	Electrical Test Benches	For hands-on testing of functionality and circuit design	6 pcs	1:5
F	**Reference Materials**			
33.	Industrial Automation Manuals	Covering principles and practices in automation	30 pcs	1:1
34.	Electrical Standards	Reference on industry standards (e.g., IEEE Guidelines)	6 pcs	1:5
35.	Technical Handbooks	On motors, drives, and wiring systems	30 pcs	1:1
36.	Training Presentations/Slides	Digital format for shared access among trainees	1	1:30
37.	Multimedia Learning Modules	Digital licenses for videos and tutorials	30 pcs	1:1
38.	Practical Assessment Guides	Worksheets for practical assessments	30 pcs	1:1

GAS METAL ARC WELDING OPERATIONS

Unit Code: 0715 451 17A

TVET CDACC UNIT CODE: ENG/CU/WEF/CR/04/5/MA

Unit Duration: 150 Hours

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Carry out Gas Metal Arc Welding Operations

Unit Description

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train GMAW operations. The learning outcomes involve carrying out metal inert gas welding, metal active gas welding, flux- cored arc welding, tungsten inert gas welding, and maintaining gas metal arc welding equipment.

Summary of Learning Outcomes

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

S/NO	Learning Outcomes	Duration (Hours)
1.	Carry out Metal inert Gas (MIG) welding	30
2.	Carry out Metal Active Gas (MAG) welding	20
3.	Carry out Flux Cored Arc Welding (FCAW)	30
4.	Carry out Tungsten Inert Gas (TIG) welding	30
5.	Maintain Gas Metal Arc Welding (GMAW) equipment	10
Totals		**120**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Carry out Metal inert Gas (MIG) welding	1.1 Occupational health and safety standards	• Written tests • Practical test • Project work

Learning Outcome	Content	Suggested Assessment Methods
	1.1.1 Workplace legislation and standards 1.1.2 Workplace hazard identification 1.1.3 Risk Assessment 1.1.4 Workshop Incident/Accident reporting 1.1.5 Workplace ergonomics and work design 1.1.6 Workshop waste management 1.1.7 Workplace environmental safety 1.1.8 Workshop safety 1.1.8.1 Regulations 1.1.8.2 Personal Protective Equipment 1.1.8.3 Layout 1.1.9 Workplace procedures 1.1.9.1 Roles and responsibilities 1.1.9.2 Compliance 1.1.9.3 Documentation 1.1.9.4 Communication 1.1.9.5 Emergency procedures 1.1.10 Welding hazards	• Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	1.1.10.1 Fire/Burns 1.1.10.2 Cuts 1.1.10.3 Fumes 1.1.10.4 Noise 1.1.10.5 Gas explosion 1.1.11 Housekeeping 1.1.11.1 Cleaning 1.1.11.2 Waste management 1.2 Drawing interpretation 1.2.1 Dimensions 1.2.2 Tolerances 1.2.3 Symbols and notations 1.3 MIG welding equipment and accessories 1.3.1 Types 1.3.1.1 Inert gas cylinders 1.3.1.2 MIG welding torch 1.3.1.3 MIG wire 1.3.1.4 MIG welding tools 1.3.1.5 Fire extinguishers 1.3.1.6 Welding jigs and fixtures 1.3.1.7 Nozzle cleaner 1.3.2 Use and care 1.4 Welding material	

Learning Outcome	Content	Suggested Assessment Methods
	preparation (0.1-16 mm thickness) 1.4.1 Measuring 1.4.2 Marking out 1.4.3 Cutting 1.4.4 Edge preparation 1.5 MIG welding parameters 1.5.1 Setting 1.5.1.1 Pre-operation checks 1.5.1.2 Working pressure 1.5.1.3 Current 1.5.1.4 Torch angle 1.5.1.5 Wire feed speed 1.5.1.6 Wire gauge/diameter 1.6 Modes of metal transfer 1.6.1 Short circuit 1.6.2 Globular 1.6.3 Spray arc 1.6.4 Pulsed 1.7 Shielding gases 1.7.1 Argon 1.7.2 Helium 1.8 Metallic Materials (0.1-16 mm thickness) 1.8.1 Plates 1.8.2 Pipes 1.9 Welding positions 1.9.1 Types	

Learning Outcome	Content	Suggested Assessment Methods
	1.9.1.1 Flat 1.9.1.2 Horizontal 1.9.1.3 Vertical 1.9.1.4 Overhead 1.9.2 Applications 1.10 Weld joints 1.10.1 Types 1.10.1.1 Butt joint 1.10.1.2 Lap joint 1.10.1.3 Edge joint 1.10.1.4 Plug joint 1.10.1.5 Corner joint 1.10.1.6 T-joint 1.10.1.7 Cruciform joint 1.10.2 Geometry and application 1.11 Weld defects 1.11.1 Types 1.11.1.1 Porosity 1.11.1.2 Undercut 1.11.1.3 Incomplete penetration 1.11.1.4 Reinforcement 1.11.1.5 Spatters 1.11.1.6 Weld craters 1.11.1.7 Weld cracks 1.11.1.8 Distortion 1.11.2 Causes and prevention 1.12 Finishing processes	

Learning Outcome	Content	Suggested Assessment Methods
	1.12.1 Methods 1.12.1.1 Buffing 1.12.1.2 Polishing 1.12.1.3 Grinding 1.12.1.4 Varnishing 1.12.1.5 Deburring 1.12.1.6 Electroplating 1.12.1.7 Painting 1.12.2 Applications **Practice** ❑ MIG weld Metallic materials plates and pipes of 4-16 mm thickness in: • Flat position • Horizontal position • Vertical position • Overhead position	
2. Carry out Metal Active Gas (MAG) welding	2.1 MAG welding equipment and accessories 2.1.1 Active gas cylinders 2.1.1.1 Applications 2.1.1.2 Care 2.2 Shielding gas 2.2.1 Carbon IV Oxide 2.3 MAG welding process 2.3.1 Procedure 2.3.2 Applications **Practice**	• Written tests • Practical test • Project work • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	❑ MAG weld metallic materials plates and pipes of 4-16 mm thickness in: • Flat position • Horizontal position • Vertical position • Overhead position	
3. Carry out Flux Cored Arc Welding (FCAW)	3.1 Flux Cored Arc Welding (FCAW) machines, tools and equipment 3.1.1 Types 3.1.2 Usage 3.1.3 Care and storage 3.2 Types of FCAW processes 3.2.1 Gas shielded 3.2.2 Self-shielded 3.3 FCAW parameters 3.3.1 Setting 3.3.1.1 Current 3.3.1.2 Shielding gas type 3.3.1.3 Shielding gas pressure 3.3.1.4 Arc force 3.4 FCAW process 3.4.1 Procedure 3.4.2 Applications **Practice**	• Written tests • Practical test • Project work • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	❑ FCAW weld Metallic materials plates and pipes of 4-16 mm thickness in: • Flat position • Horizontal position • Vertical position • Overhead position	
4. Carry out Tungsten Inert Gas (TIG) welding	4.1 TIG welding equipment and accessories 4.1.1 Types 4.1.1.1 TIG torch 4.1.1.2 Tungsten electrode 4.1.1.3 Filler wire 4.1.2 Use and care 4.2 Use and care of materials 4.2.1 Filler rod 4.3 Shielding gases 4.3.1 Argon 4.3.2 Helium 4.4 TIG process (metals up to 16 mm thickness) 4.4.1 Procedure 4.4.2 Applications **Practice** ❑ TIG weld metallic materials plates and pipes of 4-16 mm thickness in:	• Written tests • Practical test • Project work • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	• Flat position • Horizontal position • Vertical position • Overhead position	
5. Maintain Gas Metal Arc Welding (GMAW) equipment	5.1 GMAW tools repair 5.1.1 Handles 5.1.2 Heads 5.1.3 Jaws 5.1.4 Blades 5.1.5 Discs and wheels 5.2 Preventive maintenance of GMAW machines and equipment 5.2.1 Cleaning of the external surfaces of the machine 5.2.2 Inspecting cables, connectors and power sources 5.2.3 Lubricating of moving parts 5.3 Preventive maintenance report 5.3.1 Content 5.3.2 Usage and storage **Practice** ❑ Clean external surfaces of machine	• Written tests • Practical test • Project work • Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	❑ Inspect cables, connectors and power sources ❑ Lubricate moving parts ❑ Report writing.	

Suggested Delivery Methods

- ❑ Demonstration
- ❑ Group discussions
- ❑ Practical work.
- ❑ Exercises
- ❑ Industrial visits
- ❑ Online materials
- ❑ Direct instructions
- ❑ Simulation

List of Recommended Resources

Recommended Resources for 25 trainees

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Comprehensive textbooks on Welding and Fabrication	25	1:1
2.	Drawing papers	A4, A3 and A2 size drawing papers for drafting of sketches and working drawings	1 ream	
3.	Projector	Functional projector for displaying content during presentations	1	1:25

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
4.	Computer	Functional desktop computer with online instructional content	1	1:25
5.	White board	Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction	1	1:25
6.	Printer	An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings	1	1:25
B	**Learning Facilities & Infrastructure**			
7.	Lecture/Theory Room	Spacious room with seats for 25 trainees, approximately 60 sqm	1	1:25
8.	Workshop	Standard workshop with bench/fitting area and welding booths approximately 80 sqm	1	1:25
C	**Materials and Supplies**			
9.	Dust coat/ overall	Shields skin and regular clothes from sparks	25	1:
10.	Gloves	Shields hands from sharp edges, heat, and chemical exposure	25	1:1
11.	Safety boots	Protects feet from heavy objects, sharp materials, and impact.	25	1:1
12.	Welding helmets	Protecting the eyes while providing a clear view of the weld.	25	1:1

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
13.	Ear muffs/ ear plugs	Shields against prolonged exposure to high noise levels from machinery	25	1:1
14.	Safety goggles	Protects eyes from flying metal particles, sparks, and dust	25	1:1
15.	Raw materials	Metallic Materials Plates ❑ 4mm thickness. ❑ 6 mm thickness. ❑ 9 mm thickness. ❑ 12 mm thickness. ❑ 16 mm thickness Pipes ❑ 4 mm thickness ❑ 6 mm thickness ❑ 9 mm thickness ❑ 12 mm thickness ❑ 16 mm thickness		
16.	Tungsten electrodes	Electrodes used in TIG welding	Enough	
17.	FCAW electrodes	Electrodes used in FCAW welding	Enough	
18.	First Aid kit	Fully equipped First Aid kit for use in case of accidents	1	1:25
19.	Brooms and cleaning stuff	Hand brooms and mops for cleaning	10	2:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
20.	Cotton waste	Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment	Enough	
21.	Cleaning detergents	General degreasers	10 liters	
		Floor detergents	10 liters	
		Hand detergents	10 liters	
D	**Tools and Equipment**			
Measuring tools				
22.	Steel rules	Calibrated steel rules for linear measurements	20	4:5
23.	Vernier calipers	Calibrated vernier calipers for linear measurements	20	4:5
24.	Tri squares	Properly aligned steel Tri-square for checking perpendicular edges	5	1:5
25.	Vernier height gauge and surface plates	Calibrated vernier height gauges and surface plates for measurement of heights	5	1:5
26.	Measuring tapes	Calibrated measuring tapes for linear measurements	20	4:5
27.	Angle gauges	Calibrated steel rules for linear measurements	5	1:5
Marking out tools				
28.	Scribers	Quality steel pencil scribers for marking out lines on metal surfaces	20	4:5
29.	Dot punches	Quality steel dot punches for marking out centres	20	4:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
30.	Calipers	Quality steel calipers for marking out arcs on metal surfaces	5	1:5
Cutting Tools				
31.	Assorted hand files	Flat and round hand files for material preparation and finishing	20	4:5
32.	Hacksaws	Hack saws with functional frames and blades for cutting metal plates and pipes	20	4:5
33.	Tinsnips		10	2:5
34.	Angle grinders	Portable angle grinders with cutting and grinding disks for cutting and grinding metal plates and pipes	5	1:5
Work holding tools				
35.	Work benches	Stable work benches for carrying out bench work	5	1:5
36.	Collet	Hold the tungsten electrode in place	5	1:5
37.	Bench vices	Functional bench vices/clamps for holding work pieces during bench work	20	4:5
38.	Tongs	Functional pairs of tongs for holding hot pieces of metal during welding	10	2:5
Finishing tools				
39.	Wire brushes	To clean metal surfaces	20	4:5

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
40.	MIG welding wire	Acts as both the electrode and the filler material	2000kg	80:1
41.	TIG welding wire	Used as filler rods	200kg	8:1
42.	File cards	Cleaning tool used to maintain files	5	1:5
E	**Machines and Equipment**			
43.	MIG/ MAG welding machine	uses a continuous wire feed as an electrode	5	1:5
44.	MAG welding machine	Uses a non-consumable tungsten electrode	5	1:5
45.	TIG welding equipment	Functional welding equipment	5	1:5
46.	FCAW equipment	Functional welding equipment	5	1:5
47.	Firefighting equipment	for ensuring safety in fabrication workshops where fire hazards are present, such as sparks	3	
48.	Welding gun	Feeds the filler wire into the weld pool	5	1:5
F	**Reference Materials**			
49.	Working drawings	Technical welding drawings giving the specifications of the welding to be carried out	25	1:1
50.	Operation sheets	Operation sheets describing the procedures to be followed in carrying out welding	25	1:1

S/No.	Category/Item	Description/Specifications	Quantity	Recommended Ratio (Item: Trainee)
51.	Welding Procedure Specifications (WPS)	WPS to guide on the procedure and standards to be used to achieve specific types of welds	25	1:1
52.	Training Presentations/Slides	Digital format for shared access among trainees	1	1:25
53.	Practical Assessment Guides	Worksheets for practical assessments	25	1:1