****

 **THE REPUBLIC OF KENYA**

**COMPETENCY BASED CURRICULUM**

**FOR**

**WELDING AND FABRICATION**

**LEVEL 5**



 **TVET CDACC**

 **P.O. BOX 15745-00100**

 **NAIROBI**

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# FOREWORD

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

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted to the formulation of the Policy Framework for Reforming Education and Training. A key feature of this policy is the radical change in the design and delivery of the 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 mode of delivery allows 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.

It is my conviction that this Curriculum will play a great role towards development of competent human resource for the Engineering sector’s growth.

**PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING**

**MINISTRY OF EDUCATION**

# PREFACE

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

The Technical and Vocational Education and Training Act No. 29 of 2013 on Reforming Education and Training in Kenya, 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 Kenyan labour force.

TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) in conjunction with Welding Sector Skills Advisory Committee (SSAC) have developed this Curriculum.

This Curriculum has been developed following the CBET framework policy; the CBETA Standards and guidelines provided by the TVET Authority and the Kenya National Qualification framework designed by the Kenya National Qualification Authority.

This Curriculum is designed and organized with an outline of learning outcomes; Suggested Methods of Instruction, training/learning resources and methods of assessing the trainee’s achievement. The Curriculum is competency-based and allows multiple entry and exit to the course.

 I am grateful to the Council members, Council Secretariat, Welding Sector Skills Advisory Committee (SSAC), expert workers and all those who participated in the development of this Curriculum.

**CHAIRPERSON, TVET CDACC**

# ACKNOWLEDGEMENT

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 was received from various organisations.

I recognize with appreciation the role of the Welding Sector Skills Advisory Committee (SSAC) in ensuring that competencies required by the industry are addressed in the Curriculum. I also thank all stakeholders in the Welding and Fabrication sector for their valuable input and all those who participated in the process of developing this Curriculum.

I am convinced that this Curriculum will go a long way in ensuring that workers in Welding and Fabrication sector acquire competencies that will enable them to perform their work more efficiently.

**COUNCIL SECRETARY/CEO**

**TVET CDACC**

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# ABBREVIATIONS AND ACRONYMS

ASME American Society of Mechanical Engineers

BC Basic competency

BS British Standard

CBET Competency Based Education and Training

CC Common competency

CR Core competency

CU Curriculum

ENG Engineering

ISO International Organization for Standardization

KCSE Kenya Certificate of Secondary Education

KNQA Kenya National Qualifications Authority

KS Kenyan Standard

NEMA National Environmental Management Authority

OSH Occupational Safety and Health

PPE Personal Protective Equipment

TVET Technical and Vocational Education and Training

WEF Welding and Fabrication

# KEY TO UNIT CODE

 **ENG /OS /WEF/BC /01/ 5/ A**

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

Version control

# COURSE OVERVIEW

Welding and Fabrication Level 5 qualification consists of competencies that a person must achieve to enable him/her to carry out various welding processes including gas welding, manual metal arc welding, Tungsten Inert Gas (TIG) welding and Gas Metal Arc welding (GMAW). In addition, it also involves competencies for performing weld testing and fabricating products and structures.

This course consists of the following basic, common and core units of learning:

**Basic Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit factor** |
| ENG/CU/WEF/BC/01/5 | Communication skills | 25 | 2.5 |
| ENG/CU/WEF/BC/02/5 | Digital literacy | 45 | 4.5 |
| ENG/CU/WEF/BC/03/5 | Entrepreneurial skills | 70 | 7.0 |
| ENG/CU/WEF/BC/04/5 | Employability skills | 50 | 5.0 |
| ENG/CU/WEF/BC/05/5 | Environmental literacy | 25 | 2.5 |
| ENG/CU/WEF/BC/06/5 | Occupational safety and health practices | 25 | 2.5 |
| **Total** | **280** | **28.0** |

**Common Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning Code** | **Unit of Learning Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/WEF/CC/01/5 | Technical drawing | 50 | 5.0 |
| ENG/CU/WEF/CC/02/5 | Basic Mathematics | 40 | 4.0 |
| ENG/CU/WEF/CC/03/5 | Science Calculations and Electricity Basics | 30 | 3.0 |
| ENG/CU/WEF/CC/04/5 | Estimation and Costing  | 20 | 2.0 |
| **Total** | **140** | **14.0** |

**Core Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning Code** | **Unit of Learning Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/WEF/CR/01/5 | Fabrication of products and structures | 90 | 9 |
| ENG/CU/WEF/CR/02/5 | Soldering and gas welding  | 85 | 8.5 |
| ENG/CU/WEF/CR/03/5 | Manual metal arc welding  | 75 | 7.5 |
| ENG/CU/WEF/CR/04/5 | Gas Metal Arc Welding (GMAW)  | 75 | 7.5 |
| ENG/CU/WEF/CR/05/5 | Tungsten Inert Gas (TIG) welding | 75 | 7.5 |
| ENG/CU/WEF/CR/06/5 | Spot and seam resistance welding  | 40 | 4 |
| ENG/CU/WEF/CR/07/5 | Weld testing | 40 | 4 |
|  | Industrial attachment  | 360 | 36 |
| **Total** | **840** | **84** |
| **Grand total** |  **1260** | **126** |

The total duration of the course is 1260 hours including 360 hours’ industrial attachment.

**Entry Requirements**

A trainee entering this course should have any of the following minimum requirements:

1. Kenya Certificate of Secondary Education (KCSE) mean grade D (plain).

**Or**

1. Welding and Fabrication Level 4 Certificate

**Or**

1. Equivalent qualification as determined by Kenya National Qualifications Authority (KNQA).

**Trainer qualification**

A trainer for this course should have a higher qualification than the level of this course

**Industrial Attachment**

An individual enrolled in this course will undergo three hundred and sixty (360) hours industrial attachment in a welding and fabrication firm.

An individual enrolled in one of the core units of learning will undergo a forty (40) hours attachment.

**Assessment**

The course will be assessed at two levels: internal and external.

1. **Internal assessment**: conducted continuously by the trainer (internal assessor) who is monitored by an accredited internal verifier.
2. **External assessment**: conducted by an external assessor who is monitored by an accredited external verifier.

The assessors and verifiers are registered by TVET CDACC which also coordinates external assessment.

**Certification**

An individual will be awarded a Certificate of Competency on demonstration of competence in a unit of competency. To be awarded a National Certificate in Welding and Fabrication Level 5, an individual must demonstrate competence in all the units of competency as given in this qualification pack.

These certificates will be awarded by TVET CDACC in conjunction with the training provider.

# BASIC UNITS OF LEARNING

# COMMUNICATION SKILLS

**UNIT CODE: ENG**/CU/WEF/BC/01/5

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Communication Skills

**Duration of Unit:** 25hours

**Unit Description**

This unit covers the competencies required to demonstrate communication skills. It involves meeting communication needs of clients and colleagues, contributing to the development of communication strategies, conducting workplace interviews, facilitating group discussions and representing the organisation.

**Summary of Learning Outcomes**

1. Meet communication needs of clients and colleagues
2. Contribute to the development of communication strategies
3. Conduct interviews
4. Facilitate group discussions
5. Represent the organization

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Meet communication needs of clients and colleagues
 | * Communication process
* Modes of communication
* Medium of communication
* Effective communication
* Barriers to communication
* Flow of communication
* Sources of information
* Organizational policies
* Organization requirements for written and electronic communication methods
* Report writing
* Effective questioning techniques (clarifying and probing)
* Workplace etiquette
* Ethical work practices in handling communication
* Active listening
* Feedback
* Interpretation
* Flexibility in communication
 | * Interview
* Third party reports
* Written texts
 |
| 1. Contribute to the development of communication strategies
 | * Dynamics of groups
* Styles of group leadership
* Openness and flexibility in communication
* Communication skills relevant to client groups
 | * Written
* Observation
 |
| 1. Conduct interviews
 | * Types of interview
* Establishing rapport
* Facilitating resolution of issues
* Developing action plans
 | * Written
* Observation
 |
| 1. Facilitate group discussions
 | * Identification of communication needs
* Dynamics of groups
* Styles of group leadership
* Presentation of information
* Encouraging group members participation
* Evaluating group communication strategies
 | * Written
* Observation
 |
| 1. Represent the organization
 | * Presentation techniques
* Development of a presentation
* Multi-media utilization in presentation
* Communication skills relevant to client groups
 | * Observation
* Written
 |

**Suggested Methods of Instruction**

* Role playing
* Viewing of related videos

**Recommended Resources**

* Desktop computers/laptops
* Internet connection
* Projectors
* Telephone

## DIGITAL LITERACY

**UNIT CODE:** ENG/CU/WEF/BC/02/5

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Digital Literacy

**Duration of Unit:** 45 hours

**Unit Description**

This unit covers the competencies required to demonstrate digital literacy. It involves identifying appropriate computer software and hardware, applying security measures to data, hardware, software in automated environment, applying computer software in solving tasks, applying internet and email in communication at workplace, applying desktop publishing in official assignment and preparing presentation packages.

**Summary of Learning Outcomes**

1. Identify computer software and hardware
2. Apply security measures to data, hardware, software in automated environment
3. Apply computer software in solving tasks
4. Apply internet and email in communication at workplace
5. Apply desktop publishing in official assignments
6. Prepare presentation packages

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify computer hardware and software
 | * Concepts of ICT
* Functions of ICT
* History of computers
* Components of a computer
* Classification of computers
 | * Written tests
* Oral presentation
* Observation
 |
| 1. Apply security measures to data, hardware and software
 | * Data security and control
* Security threats and control measures
* Types of computer crimes
* Detection and protection against computer crimes
* Laws governing protection of ICT
 | * Written tests
* Oral presentation
* Observation
* Project
 |
| 1. Apply computer software in solving tasks
 | * Operating system
* Word processing
* Spread sheets
* Data base design and manipulation
* Data manipulation, storage and retrieval
 | * Oral questioning
* Observation
* Project
 |
| 1. Apply internet and email in communication at workplace
 | * Computer networks
* Network configurations
* Uses of internet
* Electronic mail (e-mail) concept
 | * Oral questioning
* Observation
* Oral presentation
* Written report
 |
| 1. Apply desktop publishing in official assignments
 | * Concept of desktop publishing
* Opening publication window
* Identifying different tools and tool bars
* Determining page layout
* Opening, saving and closing files
* Drawing various shapes using DTP
* Using colour pellets to enhance a document
* Inserting text frames
* Importing and exporting text
* Object linking and embedding
* Designing of various publications
* Printing of various publications
 | * Oral questioning
* Observation
* Oral presentation
* Written report
* Project
 |
| 1. Prepare presentation packages
 | * Types of presentation packages
* Procedure of creating slides
* Formatting slides
* Presentation of slides
* Procedure for editing objects
 | * Oral questioning
* Observation
* Oral presentation
* Written report
* Project
 |

**Suggested Methods of Instruction**

* Demonstration
* Viewing of related videos
* Discussions
* Assignments
* Direct instructions

**Recommended Resources**

* Computers
* Other digital devices
* Printers
* Storage devices
* Internet access
* Computer software

## ENTREPRENEURIAL SKILLS

**UNIT CODE:** ENG/CU/WEF/BC/03/5

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Entrepreneurship

**Duration of unit:** 70 hours

**Unit Description**

This unit covers the competencies required to demonstrate understanding of entrepreneurship. It involves demonstrating understanding of an entrepreneur, entrepreneurship and self-employment. It also involves identifying entrepreneurship opportunities, creating entrepreneurial awareness, applying entrepreneurial motivation and developing business innovative strategies.

**Summary of Learning Outcomes**

* 1. Demonstrate understanding of an entrepreneur
	2. Demonstrate knowledge of entrepreneurship and self-employment
	3. Identify entrepreneurship opportunities
	4. Create entrepreneurial awareness
	5. Apply entrepreneurial motivation
	6. Develop innovative business strategies
	7. Develop Business plan

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Demonstrate knowledge of entrepreneurship and self-employment
 | * Importance of self-employment
* Requirements for entry into self-employment
* Role of an Entrepreneur in business
* Contributions of Entrepreneurs to National development
* Entrepreneurship culture in Kenya
* Born or made entrepreneurs
 | * Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Identify entrepreneurship opportunities
 | * Business ideas and opportunities
* Sources of business ideas
* Business life cycle
* Legal aspects of business
* Assessment of product demand
* Business environment
* Factors to consider when evaluating business environment
* Technology in business
 | * Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Create entrepreneurial awareness
 | * Forms of businesses
* Sources of business finance
* Factors in selecting source of business finance
* Governing policies on Small Scale Enterprises (SSEs)
* Problems of starting and operating SSEs
 | * Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Apply entrepreneurial motivation
 | * Internal and external motivation
* Motivational theories
* Self-assessment
* Entrepreneurial orientation
* Effective communications in entrepreneurship
* Principles of communication
* Entrepreneurial motivation
 | * Case studies
* Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Develop business innovative strategies
 | * Innovation in business
* Small business Strategic Plan
* Creativity in business development
* Linkages with other entrepreneurs
* ICT in business growth and development
 | * Case studies
* Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Develop Business Plan
 | * Business description
* Marketing plan
* Organizational/Management
* plan
* Production/operation plan
* Financial plan
* Executive summary
* Presentation of Business Plan
 | * Case studies
* Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |

**Suggested Methods of Instruction**

* Direct instruction
* Project
* Case studies
* Field trips
* Discussions
* Demonstration
* Question and answer
* Problem solving
* Experiential
* Team training

**Recommended Resources**

* Case studies
* Business plan templates
* Computers
* Overhead projectors
* Internet
* Mobile phone
* Video clips
* Films
* Newspapers and Handouts
* Business Journals
* Writing materials

## EMPLOYABILITY SKILLS

**UNIT CODE:** ENG/CU/WEF/BC/04/5

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Employability Skills

**Duration of Unit:** 50 hours

**Unit Description**

This unit covers competencies required to demonstrate employability skills. It involves conducting self-management, demonstrating interpersonal communication, critical safe work habits, leading a workplace team, planning and organizing work, maintaining professional growth and development, demonstrating workplace learning, problem solving skills and managing workplace ethics.

**Summary of Learning Outcomes**

1. Conduct self-management

2. Demonstrate interpersonal communication

3. Demonstrate critical safe work habits

4. Lead small teams

5. Plan and organize work

6. Maintain professional growth and development

7. Demonstrate workplace learning

8. Demonstrate problem solving skills

9. Demonstrate workplace ethics

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Conduct self-management
 | * Self-awareness
* Formulating personal vision, mission and goals
* Strategies for overcoming life challenges
* Emotional intelligence
* Assertiveness versus aggressiveness
* Expressing personal thoughts, feelings and beliefs
* Developing and maintaining high self-esteem
* Developing and maintaining positive self-image
* Articulating ideas and aspirations
* Accountability and responsibility
* Good work habits
* Self-awareness
* Self-development
* Financial literacy
* Healthy lifestyle practices
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Demonstrate interpersonal communication
 | * Meaning of interpersonal communication
* Listening skills
* Types of audience
* Writing skills
* Reading skills
* Meaning of empathy
* Understanding customers’ needs
* Establishing communication networks
* Sharing information
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Demonstrate critical safe work habits
 | * Stress and stress management
* Punctuality and time consciousness
* Leisure
* Integratingpersonal objectives into organizational objectives
* Resources utilization
* Setting work priorities
* HIV and AIDS
* Drug and substance abuse
* Handling emerging issues
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Lead a small team
 | * Leadership qualities
* Team building
* Determination of team roles and objectives
* Team performance indicators
* Responsibilities in a team
* Forms of communication
* Complementing team activities
* Gender and gender mainstreaming
* Human rights
* Maintaining relationships
* Conflicts and conflict resolution
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Plan and organize work
 | * Functions of management
* Planning
* Organizing
* Time management
* Decision making process
* Task allocation
* Evaluating work activities
* Resource utilization
* Problem solving
* Collecting and organising information
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Maintain professional growth and development
 | * Opportunities for professional growth
* Assessing training needs
* Licenses and certifications for professional growth and development
* Pursuing personal and organizational goals
* Identifying work priorities
* Recognizing career advancement
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Demonstrate workplace learning
 | * Managing own learning
* Contributing to the learning community at the workplace
* Cultural aspects of work
* Variety of learning context
* Application of learning
* Safe use of technology
* Identifying opportunities
* Generating new ideas
* Workplace innovation
* Performance improvement
* Handling emerging issues
* Future trends and concerns in learning
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Demonstrate problem solving skills
 | * Problem identification
* Problem solving
* Application of problem-solving strategies
* Resolving customer concerns
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Demonstrate workplace ethics
 | * Meaning of ethics
* Ethical perspectives
* Principles of ethics
* Values and beliefs
* Ethical standards
* Organization code of ethics
* Common ethical dilemmas
* Organization culture
* Corruption, bribery and conflict of interest
* Privacy and data protection
* Diversity, harassment and mutual respect
* Financial responsibility/accountability
* Etiquette
* Personal and professional integrity
* Commitment to jurisdictional laws
* Emerging issues in ethics
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |

**Suggested Methods of Instruction**

* Demonstrations
* Simulation/Role play
* Discussion
* Presentations
* Case studies
* Q&A

**Recommended Resources**

* Computers
* Stationery
* Charts
* Video clips
* Audio tapes
* Radio sets
* TV sets
* LCD projectors

## ENVIRONMENTAL LITERACY

**UNIT CODE:** ENG/CU/WEF/BC/05/5

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Environmental Literacy

**Duration of Unit:** 25 hours

**Unit Description**

This unit describes the competencies required to demonstrate understanding of environmental literacy. It involves controlling environmental hazard, controlling control environmental pollution, complying with workplace sustainable resource use, evaluating current practices in relation to resource usage, identifying environmental legislations/conventions for environmental concerns, implementing specific environmental programs and monitoring activities on environmental protection/programs.

**Summary of Learning Outcomes**

1. Control environmental hazards
2. Control environmental Pollution
3. Demonstrate sustainable use of resource
4. Evaluate current practices in relation to resource usage
5. Identify Environmental legislations/conventions for environmental concerns
6. Implement specific environmental programs
7. Monitor activities on Environmental protection/Programs

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** |  **Content** | **Suggested Assessment Methods** |
| 1. Control environmental hazards
 | * Purposes and content of Environmental Management and Coordination Act 1999
* Purposes and content of Solid Waste Act
* Storage methods for environmentally hazardous materials
* Disposal methods of hazardous wastes
* Types and uses of PPE in line with environmental regulations
* Occupational Safety and Health Standards (OSHS)
 | * Written test
* Oral questions
* Observation
 |
| 1. Control environmental Pollution control
 | * Types of pollution
* Environmental pollution control measures
* Types of solid wastes
* Procedures for solid waste management
* Different types of noise pollution
* Methods for minimizing noise pollution
 | * Written test
* Oral questions
* Observation
 |
| 1. Demonstrate sustainable resource use
 | * Types of resources
* Techniques in measuring current usage of resources
* Calculating current usage of resources
* Methods for minimizing wastage
* Waste management procedures
* Principles of 3Rs (Reduce, Reuse, Recycle)
* Methods for economizing or reducing resource consumption
 | * Written test
* Oral questions
* Observation
 |
| 1. Evaluate current practices in relation to resource usage
 | * Collection of information on environmental and resource efficiency systems and procedures,
* Measurement and recording of current resource usage
* Analysis and recording of current purchasing strategies.
* Analysis of current work processes to access information and data
* Identification of areas for improvement
 | * Written test
* Oral questions
* Observation
 |
| 1. Identify Environmental legislations/conventions for environmental concerns
 | * Environmental issues/concerns
* Environmental legislations /conventions and local ordinances
* Industrial standard /environmental practices
* International Environmental Protocols (Montreal, Kyoto)
* Features of an environmental strategy
 | * Written questions
* Oral questions
* Observation
 |
| 1. Implement specific environmental programs
 | * Community needs and expectations
* Resource availability
* 5 s of good housekeeping
* Identification of programs/Activities
* Setting of individual roles /responsibilities
* Resolving problems /constraints encountered
* Consultation with stakeholders
 | * Written questions
* Oral questions
* Observation
 |
| 1. Monitor activities on Environmental protection/Programs
 | * Periodic monitoring and Evaluation of activities
* Gathering feedback from stakeholders
* Analysing data gathered
* Documentation of recommendations and submission
* Setting of management support systems to sustain and enhance the program
* Monitoring and reporting of environmental incidents to concerned /proper authorities
 | * Oral questions
* Written tests
* Practical test
* Observation
 |

**Suggested Methods of Instruction**

* Instructor led facilitation of theory
* Demonstration by trainer
* Viewing of related videos
* Project
* Assignements
* Role play

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Environmental Management and Coordination Act 1999
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE)
* ISO standards
* Ccompany environmental management systems (EMS)
* Montreal Protocol
* Kyoto Protocol

## OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE:** ENG/CU/WEF/BC/06/5

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Occupational Safety and Health Practices

**Duration of Unit:** 25 hours

**Unit Description**

This unit specifies the competencies required to identify workplace hazards and risk, identify and implement appropriate control measures and implement OSH programs, procedures and policies/ guidelines

**Summary of Learning Outcomes**

1. Identify workplace hazards and risk
2. Control OSH hazards
3. Implement OSH programs

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify workplace hazards and risks
 | * Identification of hazards in the workplace and/or the indicators of their presence
* Evaluation and/or work environment measurements of OSH hazards/risk existing in the workplace is conducted by
* Authorized personnel or agency
* Gathering of OHS issues and/or concerns raised
 | * Oral questions
* Written tests
* Portfolio of evidence
* Third party report
 |
| 1. Control OSH hazards
 | * Prevention and control measures, including use of PPE (personal protective equipment) for specific hazards are identified and implemented
* Appropriate risk controls based on result of OSH hazard evaluation is recommended
* Contingency measures, including emergency procedures during workplace incidents and emergencies are recognized and established in accordance with organization procedures
 | * Oral questions
* Written tests
* Portfolio of evidence
* Third party report
 |
| 1. Implement OSH programs
 | * Providing information to work team about company OHS program, procedures and policies/guidelines
* Participating in implementation of OSH procedures and policies/ guidelines
* Training of team members and advice on OSH standards and procedures
* Implementation of procedures for maintaining OSH-related records
 | * Oral questions
* Written tests
* Portfolio of evidence
* Third party report
 |

**Suggested Methods of Instruction**

* Assigments
* Discussion
* Q&A
* Role play
* Viewing of related videos

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE) e.g.
* Mask
* Face mask/shield
* Safety boots
* Safety harness
* Arm/Hand guard, gloves
* Eye protection (goggles, shield)
* Hearing protection (ear muffs, ear plugs)
* Hair Net/cap/bonnet
* Hard hat
* Face protection (mask, shield)
* Apron/Gown/coverall/jump suit
* Anti-static suits
* High-visibility reflective vest

# COMMON UNITS OF LEARNING

## TECHNICAL DRAWING

**UNIT CODE: ENG/CU/WEF/CC/01/5/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply Technical Drawing

**Duration of Unit:** 50 hours

**Unit Description**

This unit covers the competencies required to apply technical drawings. It involves competencies to select, use and maintain drawing equipment, materials and application of CAD packages. It also involves competencies of interpreting drawing, applying plain geometry drawings, solid geometry drawings, pictorial, free hand sketching and orthographic drawings of components.

**Summary of Learning Outcomes**

1. Use and maintain drawing equipment and materials
2. Produce plain geometry drawings
3. Apply solid geometry drawings
4. Develop object surfaces
5. Apply pictorial and orthographic drawings of components
6. Apply free hand sketching

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Use and maintain drawing equipment and materials
 | * Identification, care and use of drawing equipment
* Identification, care and use of drawing materials
* Drawing paper lay out
* Application of CAD packages
	+ Meaning and types of CAD e.g.
* Auto CAD
* Solid works
* 2D and 3Ddrafting techniques
* Lettering
 | * Observation
* Written tests
 |
| 1. Produce plain geometry drawings
 | * Types of lines in drawings
* Dimensioning techniques
* Types scales
* Construction of geometric forms
* Construction of different angles
* Measurement of different angles
* Bisection of different angles and lines
* Standard drawing conventions and symbols
 | * Written tests
* Observation
 |
| 1. Apply solid geometry drawings
 | * Application of drawings and sketches of isometric objects
* Application of patterns
 | * Observation
* Written tests
 |
| 1. Apply pictorial and orthographic drawings of components
 | * Meaning of pictorial and orthographic drawings and sectioning
* Meaning of symbols and abbreviations
* Drawing of isometric, oblique, axonometric, auxiliary and perspective views
* Drawing of first and third angle projections
* Sectioning of components
* Assembly of components
 | * Observation
* Written test
 |
| 1. Develop object surfaces
 | * Patterns
* Surface development of objects
 | * Observation
* Written test
 |
| 1. Apply free hand sketching
 | * Free hand drawing techniques
* Drawing geometrical forms
 | * Observation
* Written tests
 |

**Suggested Methods of Instruction**

* Demonstration
* Practice by the trainee
* Group discussions
* Direct instructions

**Recommended Resources**

* + Drawing room
	+ Computer lab
	+ Drawing equipment and materials
	+ CAD package
	+ Projector

## BASIC MATHEMATICS

**UNIT CODE: ENG/CU/WEF/CC/02/5/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply Basic mathematics

**Duration of Unit:** 40 hours

**Unit Description**

This unit describes the competencies required by a craft person in order to apply algebra, apply ratio calculations, apply trigonometric functions, carry out mensuration, apply statistics, apply vector and apply commercial calculations.

**Summary of Learning Outcomes**

1. Apply Algebra
2. Apply ratio calculations
3. Apply Trigonometry
4. Carry out Mensuration
5. Apply Statistics
6. Apply Vector
7. Apply commercial calculations

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + 1. Apply Algebra
 | * Conversion of numbers
* Indices and laws of Indices
* Logarithms and laws of logarithms
* Calculations involving logarithms
* Algebra expressions
* Transpose of formulae
* Simultaneous equations
* Quadratic equations
 | * Written tests
* Oral questioning
* Assignments
* Simulated tests
 |
| 2. Apply ratio calculations  | * Rational and irrational numbers
* Expressions of ratios
* Direct and inverse proportions
* Solving problems on ratios
 | * Written tests
* Oral questioning
* Assignments
* Simulated tests
 |
| 3. Apply Trigonometry | * Linear graphs
* Interpret linear graphs
* Solving linear graph problems
* Trigonometric rules
* Solving Trigonometry problems
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 4. Carry out Mensuration | * Units of measurements
* Perimeter and areas of regular & irregular figures
* Volume of regular& Irregular solids
* Surface area of regular & irregular solids
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 5. Apply Statistics | * Grouped and ungrouped data Tabulation of statistical data
* Measures of central tendency mean, mode, range, Standard deviation and median
* Measures of dispersion
	+ Variance and standard deviation
* Interpretation and representation of statistical data
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
* Simulation
* Data modelling
 |
| 6. Apply Vectors | * Vectors and scalar in two and three dimensions
* Operations on vectors: Addition, Subtraction and Multiplication
* Position vectors
* Resolution of vectors
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 7. Apply commercial calculations  | * Calculation of Exchange rates
* Calculation of simple and compound interest
* Calculation of prices, profit and loss
* Calculation of hire purchase
* Calculation of price appreciation and depreciation
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |

**Suggested Methods of Instruction**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

* Scientific Calculators
* Rulers, pencils, erasers
* Charts with presentations of data
* Graph books
* Computers with internet connection

## SCIENCE CALCULATIONS AND ELECTRICITY BASICS

**UNIT CODE: ENG/CU/WEF/CC/03/5/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform science calculations and apply electricity basics.

**Duration of Unit:** 30 hours

**Unit Description**

This unit describes the competencies required by a craft person in order to apply electricity basics in their work. It includes competencies in utilizing engineering materials, calculating force, work, energy and power, performing motion calculations, force moments calculations, friction force calculations, density and pressure calculations and applying electricity basics

**Summary of Learning Outcomes**

1. Utilize engineering materials
2. Calculate force, work energy, and power
3. Perform motion calculations
4. Perform force moments basic calculations
5. Perform friction force calculations
6. Perform density and pressure calculations
7. Apply electricity basics

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Utilize engineering materials
 | * Types of materials
* Material properties
* Definition of mechanical properties of materials
* Effects of environmental factors on material properties
* Types of corrosion
* Causes of corrosion
* Methods of corrosion prevention
* Safety in corrosion prevention
* Heat treatment processes
* Application of materials
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Calculate force, work energy, and power
 | * Definition of units of measurements
* Conversion of measurement units
* Definition of work, force, mechanical advantage, velocity ratio and efficiency
* Newton’s laws of motion
* Conversion and SI units of energy, power and work
* Calculation of Efficiency
* Illustrations on Simple machines
	+ Gear trains
	+ Pulley system, hoists and lifts
	+ Screws
* Applications of work energy and power
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Perform motion calculations
 | * Definition of vectors and scalar quantities
* Newton’s law of motion
* Definition of Law of momentum
* Applications of momentum
* Definition displacement
* Solving displacement problems
* Resolutions of forces in components
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Perform force moments basic calculations
 | * Definition of force of gravity
* Definition of moments of forces
* Calculation of moments of moments force
* Applications of moments of forces
* Solving problems of force of gravity
* Illustrations of force moments
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Perform friction force calculations
 | * Definition of friction
* Advantages and disadvantages of friction forces
* Solving problems in coefficient of friction
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Perform density and pressure calculations
 | * Definition of density
* Definition of pressure
* Application of density
* Applications of pressure concepts
* Solving problems in density and pressure
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Apply electricity basics
 | * Definition of electrical terminologies
* Basic SI units
* Derived units
* Units of electrical quantities
* Solving problems of electrical quantities
* Description of electrical distribution and power conversion
* Description and application of transformers
* Description and application of rectifiers
* Explanation of electrical hazards
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercise
 |

**Suggested Methods of Instruction**

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

**Recommended Resources**

* Scientific Calculators
* Relevant reference materials
* Stationeries
* Relevant practical materials
* Computers with internet connection

## ESTIMATION AND COSTING

**UNIT CODE:** ENG/CU/WEF/CC/04/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply estimation and costing

**Duration of Unit:** 20 hours

**Unit Description:**

This unit describes the competencies required by a craft person in order to interpret specifications of a given project, analyse material quantities, prepare bill of quantities and undertake purchase and stock control.

**Summary of Learning Outcomes**

1. Interpret specifications of a given project
2. Prepare quantities information
3. Prepare bill of quantities
4. Undertake purchase and stock control

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Interpret specifications of a given project
 | * Interpretation of project specifications
* Analysis of material quantities
* Description of labour and overheads elements
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Prepare quantities information
 | * Explanation of information sources
* Explanation of items, unit prices and unit description variables
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Prepare bill of quantities
 | * Definition of bill of quantities.
* Preparation of bill of quantities form.
* Description of material prices, description and quantity.
* Calculation of labour, overhead costs, profit margin and provisional sum.
* Preparation of material requisition order.
* Preparation of purchase order.
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Undertake purchase and stock control
 | * Definition of purchasing
* Explanation of purchasing functions
* Explanation of factors affecting store inventory
* Qualities and knowledge requirement of a purchasing officer
* Explanation of factors controlling purchasing
* Explanation of purchasing methods
* Definition of stock control
* Explanation of stock taking procedures
* Explanation of functions of stores control
* Explanation of store procedures
* Description of store organisation
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |

**Suggested Methods of Instruction**

* Demonstration by trainer
* Discussions
* Practical work by trainee(s)
* Exercises
* Industrial visits
* YouTube for teaching/learning and inspiration
* Simulations
* Power point presentation

**Recommended Resources**

* Scientific Calculators
* Rulers, pencils, erasers
* Relevant reference materials
* Computers with internet connection

# CORE UNITS OF LEARNING

## FABRICATION OF PRODUCTS AND STRUCTURES

**UNIT CODE: ENG/CU/WEF/CR/01/5/A**

**Relationship to Occupational Standards**

This unit of learning addresses the unit of competency: Fabricate products and structures

**Duration of Unit:** 90 hours

**Unit Description**

This unit specifies competencies required for interpreting working drawing, selecting materials, tools and equipment, measuring and marking out product profile , cutting out product profile and working the profile to size. It also includes competencies to carrying out finishing process and conducting work place housekeeping.

**Summary of Learning Outcomes**

1. Lay out product/ structure
2. Produce products and structures
3. Conducting work place housekeeping

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Lay out product and structure
 | * Observation of safety
* Factors to consider when selecting materials
* Types and application of;
	+ Measuring and checking tools
	+ Marking out tools
	+ Cutting tools and equipment
	+ Forming tools and equipment
	+ Shaping tools and equipment
	+ Rolling tools and equipment
* Identification of template materials
* Application of templates
 | * Observation
* Product checklist
* Oral questioning
* Written tests
 |
| 1. Produce products and structures
 | * Observation of safety
* Processes of;
	+ Cutting
	+ Forming
	+ Shaping
	+ Rolling
* Types and application of material joining processes
	+ Fasteners
	+ Welding
* Factors to consider in assembly of components
* Samples of fabricated products and structures
* Quality requirements for fabricated works
* Factors to consider in selecting finishing process
* Types of finishing process
* Deburring
* Polishing
* Painting
* Varnishing
* Oil blackening
* Bluing
* Machining
* Application of finishing processes
 | * Observation
* Product checklist
* Oral questioning
 |
| 1. Conducting work place housekeeping

  | * Workstation cleaning
* Care and storage of tools and equipment
* Storage of materials and consumables
* Waste disposal procedures
 | * Observation
* Oral questioning
* Written tests
 |

**Suggested Methods of Instruction**

* Trainer led facilitation of theory
* Demonstration of task by trainer
* Practice by trainee
* Industrial visits
* Viewing of videos of fabrication processes

**Recommended Resources**

* Measuring and checking tools
* Marking out tools
* Forming tools
* Shaping tools
* Rolling tools
* Templates
* Cutting tools
* Finishing tools and equipment
* Sample fabricated products and structures

## SOLDERING AND GAS WELDING

**UNIT CODE: ENG/CU/WEF/CR/02/5/A**

**Relationship to Occupational Standards**

This unit of learning addresses the unit of competency: Perform soldering and gas welding

**Duration of Unit:** 85 hours

**Unit Description**

This unit specifies competencies required for setting up equipment and materials, carrying out soldering process, setting up gas welding equipment and materials, carrying gas welding, setting gas cutting equipment and materials and carrying out gas cutting operation,

**Summary of Learning Outcomes**

1. Set up soldering equipment and materials
2. Carry out soldering process
3. Set up gas welding equipment and materials
4. Carry out gas welding
5. Set up gas cutting equipment and materials
6. Carry out gas cutting operation

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Set up soldering equipment and materials
 | * Observation of safety in soldering
* Interpretation of working drawings
* Identification and selection of materials, tools and equipment
* Joint geometry preparation
* Steps of setting up soldering tools and equipment
 | * Observation
* Oral questioning
* Written tests
 |
| 1. Carry out soldering process
 | * Observation of safety in soldering
* Types of soldering processes
	+ Soft soldering
	+ Hard soldering (brazing)
* Types and uses of solders and fluxes
* Soft soldering process
* Hard soldering process
* Advantages and limitations of soft and hard soldering
* Applications of soldering
* Soldering workplace housekeeping
	+ Workstation cleaning
	+ Care and storage of tools and equipment
	+ Unused soldering consumables
	+ Waste disposal
 | * Oral Questioning
* Oral questioning
* Written tests
 |
| 1. Set up gas welding equipment and materials
 | * Observation of safety in gas welding
* Interpretation of working drawings
* Selection of materials, equipment and accessories
* Joint geometry preparation
* Steps of setting up gas welding equipment and accessories
 | * Observation
* Oral questioning
* Written tests
* Practical tests
 |
| 1. Carry out gas welding
 | * Observation of safety in gas welding
* Gas welding equipment and accessories
	+ Use
	+ Care and maintenance
* Welding gases
	+ Oxygen
	+ Fuel gas (Acetylene)
	+ Hydrogen, etc.
* Procedure for lighting and shutting off gas welding flame
* Types of gas welding flames
* Welding joints, symbols and abbreviations
* Use of filler metals
* Gas welding materials
* Mild steel
* Copper and its alloys
* Shapes of materials
	+ - Plates
		- Tubes
		- Metal sheets
		- Pipes
		- Flat bars
		- Spring bars
* Gas welding process
* Gas welding techniques and patterns
* Welding positions
* Gas welding defects, causes and remedies
* Advantages and limitations of gas welding
* Applications of gas welding
* Quality requirements for welding (ISO 3834)
	+ Visual inspection of the weld (ISO 17637 standard)
* Gas welding workplace housekeeping
	+ Workstation cleaning
	+ Care and storage of tools and equipment
	+ Unused welding consumables
	+ Waste disposal
 | * Observation
* Oral questioning
* Written tests
 |
| 1. Set up gas cutting equipment and materials
 | * Observation of safety in gas cutting
* Interpretation of working drawings
* Selection of materials, equipment and accessories
* Setting up gas cutting torch
 | * Observation
* Oral questioning
* Written tests
 |
| 1. Carry out gas cutting operation
 | * Observation of safety in gas cutting
* Gas cutting equipment and accessories
* Gas cutting process
* Gas cutting defects, causes and remedies
* Features of a quality kerf
* Gas cutting workplace housekeeping
	+ Workstation cleaning
	+ Care and storage of tools and equipment
	+ Unused materials
	+ Waste disposal
 | * Observation
* Oral questioning
* Written tests
 |

**Suggested Methods of Instruction**

* Facilitation of theory by trainer
* Demonstration of task by trainer
* Practice by trainee
* Viewing videos of soldering, brazing, oxy-acetylene welding and cutting process
* Industrial visits

**Recommended Resources**

* Personal Protective Equipment (PPE)
* Welding suit (fire proof)
* Gas /soldering welding goggles
* Special fire proof head cap
* Safety boots
* Gas welding gloves
* Welding Apron
* Soldering tools and equipment
* Welding bay /booth
* Gas manifold system/ trolleys
* Gas welding equipment and accessories
* Gas cutting equipment and accessories
* Gas welding consumables
	+ Filler metals
* Gas welding materials
	+ Mild steel
	+ Copper and its alloys
* Soldering and brazing materials
	+ Mild steel
	+ Stainless steel
* Soldering consumables
	+ Soldering flux
	+ Brazing rods and solders
	+ Brazing fluxes
* Finishing tools and equipment
* Soldering and gas welding video clips

## MANUAL METAL ARC WELDING

**UNIT CODE: ENG/CU/WEF/CR/03/5/A**

**Relationship to Occupational Standards**

This unit of learning addresses the unit of competency: Perform manual metal arc welding

**Duration of Unit:** 75 hours

**Unit Description**

This unit specifies competencies required to prepare materials, set up Manual Metal Arc (MMA) equipment and apply safety in MMA welding. It involves competencies to weld in all positions using manual metal arc welding process. It is also known as Shielded Metal Arc Welding (SMAW).

**Summary of Learning Outcomes**

1. Set up MMA equipment and materials
2. Carry out MMA welding

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Set up MMA equipment and materials
 | * Observation of safety in welding workshop
	+ Workplace safety procedures
	+ Factory’s Act abstract, 2007
* Interpretation of working drawings
* Selection of materials, tools and equipment
* Joint geometry preparation
* Steps of setting up MMA equipment
* Factors determining welding parameters
 | * Oral Questioning
* Practical Tests
* Written tests
 |
| 1. Carry out MMA welding
 | * Observation of safety in MMA welding
* Types of MMA welding equipment and accessories
* AC/DC welding polarity
* Principle of MMA welding process
* MMA welding specification procedure
* Methods of striking an arc
	+ Scratching
	+ Tapping
* Types and uses of electrodes
* Care and storage of electrodes
* Factors affecting quality of weld
	+ Arc length
	+ Travel speed
	+ Current setting/amperage
	+ Angle of electrode
* Manual metal arc welding process of:
	+ Mild steel (A SME IX, ISO 9606-1)
* Welding joints, symbols, abbreviations and positions
* Welding patterns
* MMA welding defects, causes and remedies
* Welding quality requirements (ISO 3834)
* Post weld treatment
	+ Heat treatment
	+ Peening
	+ Dressing
* Advantages and limitations of MMA welding
* Applications of MMA welding
* MMA welding workplace housekeeping
	+ Workstation cleaning
	+ Care and storage of tools and equipment
	+ Waste disposal
 | * Oral Questioning
* Practical Tests
* Written tests
 |

**Suggested Methods of Instruction**

* Facilitation of theory by trainer
* Demonstration of task by trainer
* Practice by trainee
* Viewing videos of MMA welding
* Viewing welding simulations
* Industrial visits

**Recommended Resources**

* Personal Protective Equipment
* Welding overall
* MMA welding shades/lens and goggles
* Special fire proof head cap
* Safety boots
* MMA welding gloves
* Ear plugs
* Welding apron
* Welding bay/welding booth
* MMA welding tools, equipment and accessories
* Welding materials
* Welding electrodes
* Video clips on MMA welding
* Heat treatment furnace

## GAS METAL ARC WELDING (GMAW)

**UNIT CODE: ENG/CU/WEF/CR/04/5/A**

**Relationship to Occupational Standards**

This unit of learning addresses the unit of competency: Perform GMA welding

**Duration of Unit:** 75 hours

**Unit Description**

This unit specifies competencies required for material preparation, setting up of GMAW welding equipment and application of safety in GMA welding. It involves competencies in thermal joining of metals using consumable electrodes. GMAW encompasses Metal Inert Gas (MIG) and Metal Active Gas (MAG) welding processes.

**Summary of Learning Outcomes**

1. Set up GMAW equipment and materials
2. Carry out GMAW welding

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Set up GMAW equipment and materials
 | * Observation of safety in GMAW
* Interpretation of working drawings
* Selection of materials, tools and equipment
* Joint design preparation
* Steps of setting up GMAW equipment
 | * Oral Questioning
* Practical Tests
* Written tests
 |
| 1. Carry out GMAW welding
 | * Observation of safety in GMAW
* GMAW equipment and accessories
* AC/DC welding polarity
* GMAW specification procedure
* Principle of GMAW process
* Electrodes wire feed mechanism
* Factors affecting quality of weld:
	+ Arc length
	+ Travel speed
	+ Current setting/amperage
	+ Angle of welding gun
* GMAW process of:
	+ Mild steel (ISO 9606)
	+ Aluminium and its alloys
	+ Copper and its alloys
	+ Stainless steel
* Welding joints, symbols, abbreviations and positions
* GMAW defects, causes and remedies
* Advantages and limitations of GMAW
* Welding quality requirements (ISO 3834)
* GMAW workplace housekeeping
	+ Workstation cleaning
	+ Care and storage of tools and equipment
	+ Waste disposal
 | * Written Test
* Practical Tests
* Oral questioning
 |

**Suggested Methods of Instruction**

* Facilitation of theory by trainer
* Demonstration of task by trainer
* Practice by trainee
* Viewing videos of GMAW welding processes
* Viewing simulation of GMAW processes
* Industrial visits

**Recommended Resources**

* Personal Protective Equipment
* Welding overall
* MAG welding shades and goggles
* Special fire proof head cap
* Safety boots
* MAG welding gloves
* Ear plugs
* Welding Apron
* Welding bay/welding booth
* GMAW welding tools, equipment and accessories
* Welding materials
	+ Mild steel
	+ Aluminium and its alloys
	+ Copper and its alloys
	+ Stainless steel
* Video clips on MAG welding

## TUNGSTEN INERT GAS (TIG) WELDING

**UNIT CODE: ENG/CU/WEF/CR/05/5/A**

**Relationship to Occupational Standards**

This unit of learning addresses the unit of competency: Perform TIG welding

**Duration of Unit:** 75 hours

**Unit Description**

This unit specifies competencies required for material preparation, setting up of Tungsten Inert Gas (TIG) welding equipment and application of safety in TIG welding. It also includes competencies in thermal joining of metals using non-consumable electrodes. It is also known as Gas Tungsten Arc Welding (GTAW).

**Summary of Learning Outcomes**

1. Set up TIG equipment and materials
2. Carry out TIG welding

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Set up TIG equipment and materials
 | * Observation of safety in TIG welding
* Interpretation of working drawings
* Welding specification procedure
* Selection of materials, tools and equipment
* Joint design preparation
* Steps of setting up TIG equipment
 | * Oral Questioning
* Practical Tests
* Written tests
 |
| 1. Carry out TIG welding
 | * Observation of safety in TIG welding
* TIG equipment and accessories
* AC/DC welding polarity
* Principle of TIG welding process
* Non-consumable electrode materials and application
* Filler metal materials and application
* TIG welding gases
* Factors affecting quality of weld
	+ Arc length
	+ Travel speed
	+ Current setting/amperage
	+ Angle of welding gun
	+ Access of joint\*
* TIG welding process of:
	+ Mild steel (ISO 9606)
	+ Alloy steel (ISO 9606)
	+ Aluminium
	+ Stainless steel
* Welding joints, symbols, abbreviations and positions
* TIG welding defects, causes and remedies
* Advantages and limitations of TIG welding
* TIG welding specification procedure
* Quality requirements for welding (ISO 3834)
* TIG welding workplace housekeeping
	+ Workstation cleaning
	+ Care and storage of tools and equipment
	+ Waste disposal
 | * Oral Questioning
* Practical Tests
* Written tests Projects
 |

**Suggested Methods of Instruction**

* Facilitation of theory by trainer
* Demonstration of task by trainer
* Practice by trainee
* Viewing videos of TIG welding
* Viewing TIG welding simulations
* Industrial visits

**Recommended Resources**

* Personal Protective Equipment
* Welding overall
* TIG welding shades and goggles
* Special fire proof head cap
* Safety boots
* TIG welding gloves
* Ear plugs
* Welding bay/welding booth
* TIG welding tools, equipment and accessories
* Welding materials
	+ Mild steel
	+ Alloy steels
	+ Aluminium and aluminium alloys
	+ Stainless steel
* Video clips on TIG welding

## SPOT AND SEAM RESISTANCE WELDING

**UNIT CODE: ENG/CU/WEF/CR/06/5/A**

**Relationship to Occupational Standards**

This unit of learning addresses the unit of competency: Perform spot and seam welding processes

**Duration of Unit:** 40 hours

**Unit Description**

This unit of competency specifies competencies required for setting up spot equipment and materials, carrying out spot welding, setting up seam equipment and materials and carrying out seam welding

**Summary of Learning Outcomes**

1. Set up of spot equipment and materials
2. Carry out spot welding
3. Set up of seam equipment and materials
4. Carry out seam welding

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Set up spot equipment and materials
 | * Observation of health and safety in spot welding
* Interpretation of working drawing
* Selection of materials, tools and equipment
* Joint surface preparation
* Steps of setting up spot tools and equipment
 | * Oral Questioning
* Practical Tests
* Written tests
 |
| 1. Carry out spot welding
 | * Observation of health and safety in spot welding
* Spot equipment and accessories
* Spot welding specification procedure
* Principle of spot welding process
* Advantages and limitations of spot welding
* Factors affecting quality of weld
	+ Current setting/amperage
	+ Time
	+ Pressure
* Spot welding process
* Welding quality requirements (ISO 3834)
* Spot welding defects, causes and remedies
* Spot welding workplace housekeeping
	+ Workstation cleaning
	+ Care and storage of tools and equipment
	+ Waste disposal
* Spot welding of mild steel (ISO 9606)
 | * Oral Questioning
* Practical test
* Written tests
 |
| 1. Set up seam equipment and materials
 | * Observation of health and safety in seam welding
* Interpretation of working drawing
* Selection of materials, tools and equipment
* Joint surface preparation
* Steps of setting up seam tools and equipment
 | * Observation
* Oral questioning
* Written tests
 |
| 1. Carry out seam welding
 | * Observation of health and safety in seam welding
* Seam equipment and accessories
* Seam welding specification procedure
* Principle seam welding process
* Advantages and limitations of seam welding
* Quality requirements for welding (ISO 3834)
* Factors affecting quality of weld
	+ Current setting/amperage
	+ Time
	+ Pressure
* Seam welding process
* Seam welding defects, causes and remedies
* Seam welding workplace housekeeping
	+ Workstation cleaning
	+ Care and storage of tools and equipment
	+ Waste disposal
* Seam welding of mild steel (ISO 9606)
 | * Observation
* Product checklist
* Oral questioning
 |

**Suggested Methods of Instruction**

* Trainer led facilitation of theory
* Demonstration of task by trainer
* Practice by trainee
* Industrial visits
* Viewing videos of spot and seam welding

**Recommended Resources**

* Personal Protective Equipment
	+ - Welding overall
		- Safety goggles
		- Special fire proof head cap
		- Safety boots
		- Spot and seam welding gloves
		- Ear plugs
		- Welding Apron
* Welding bay/welding booth
* Spot and Seam welding tools, equipment and accessories
* Welding materials
* Video clips on spot and seam welding

## WELD TESTING

**UNIT CODE: ENG/CU/WEF/CR/07/5/A**

**Relationship to Occupational Standards**

This unit of learning addresses the unit of competency: Perform weld testing

**Duration of Unit:** 40 hours

**Unit Description**

This unit of competency specifies competencies required while observing safety to set up testing equipment and Accessories and perform welding Testing

**Summary of Learning Outcomes**

1. Set up testing equipment and accessories
2. Perform weld testing

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Set up testing equipment and accessories
 | * Observation of safety in testing of weld
* Description of weld testing process
* Significance of weld quality assurance (ISO 3834)
	+ Start/stop of welds
	+ Root penetration
	+ Capping/sealing runs
	+ Undercut, etc.
* Features of a quality weld
* Selection of testing materials, tools and equipment
* Calibration of weld testing equipment
* Preparation of materials for tests
	+ Slag
	+ Profile and dimensions
	+ Grinding
 | * Observation
* Product checklist
* Oral questioning
* Written tests
 |
| 1. Perform weld testing
 | * Types of weld tests (ISO 17635, ISO 17637, ISO 17640)
	+ Destructive tests
	+ Non-destructive tests
* Advantages and limitations of weld tests
* Process of conducting weld tests
	+ Destructive tests
	+ Non-destructive tests
* Recording procedure of test results
* Care, storage and maintenance of test tools and equipment
 | * Observation
* Product checklist
* Oral questioning
* Practical tests
 |

**Suggested Methods of Instruction**

* Trainer led facilitation of theory
* Demonstration of task by trainer
* Practice by trainee
* Industrial visits
* Viewing videos of metal finishing processes
* Viewing videos of weld testing

**Recommended Resources**

* Measuring and checking tools
* Marking out tools
* Forming tools
* Cutting tools
* Finishing tools and equipment