

**REPUBLIC OF KENYA**

**COMPETENCY BASED CURRICULUM**

**FOR**

**MECHANICAL PRODUCTION (GRINDING AND FABRICATION)**

**LEVEL 4**



TVET CDACC

P.O BOX 15745-00100

NAIROBI

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**Council Secretary/CEO**

**TVET Curriculum Development, Assessment and Certification Council**

**P.O. Box 15745–00100 Nairobi, Kenya**

**Email: cdacc.tvet@gmail.com**

**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 Kenya’s development blue print 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 mechanical sector’s growth and sustainable development.

**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 toreform 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 Mechanical Engineering 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 delivery methods, 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, Mechanical engineering SSAC, expert workers and all those who participated in the development of this curriculum.

**Prof. CHARLES M. M. ONDIEKI, PhD, FIET (K), Con. Eng. Tech. CHAIRMAN, 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 organizations.

I recognize with appreciation the role of the Mechanical Engineering Sector Skills Advisory Committee (SSAC) in ensuring that competencies required by the industry are addressed in the curriculum. I also thank all stakeholders in Mechanical Engineering 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 Mechanical Sector acquire competencies that will enable them to perform their work more efficiently.

**DR. LAWRENCE GUANTAI M’ITONGA, PhD**

**COUNCIL SECRETARY/CEO**

**TVET CDACC**

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# ACRONYMNS AND ABBREVIATIONS

A Control Version

BC Basic Competencies

CC Common Competencies

CDACC Curriculum Development, Assessment and Certification Council

CR Core Competencies

CU Curriculum

EBK Engineers Board of Kenya

EBP Engineering best practice

EHS Environment, Health and Safety

ENG Engineering

IBMS Integrated Building Management System

IEE Institute of Electrical Engineers

KEBS Kenya Bureau of Standards

ME Mechanical Engineering

NCA National Construction Authority

OS Occupational Standards

OSHA Occupational Safety and Health Act

PPE Personal Protective Equipment

SOP Standard operating procedure

TVET Technical and Vocational Education and Training

WIBA Work injury benefits Act

# KEY TO UNIT CODE

ENG/CU/ME/BC/01/4/A

Industry or sector

Curriculum

Occupational area

Type of competency

Competency number

Competency level

Control version

**OVERVIEW**

**Description of the course**

This course is designed to equip a mechanical production (Grinding and fabrication) artisan with the competencies required to perform various duties as outlined in the curriculum in the mechanical sector.

The course consists of basic, common and core units of learning as indicated below:

**Basic Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/ME/BC/01/4/A | Communication skills | 20 | 2 |
| ENG/CU/ME/BC/02/4/A | Numeracy skills | 25 | 3 |
| ENG/CU/ME/BC/03/4/A | Digital Literacy | 35 | 3 |
| ENG/CU/ME/BC/04/4/A | Entrepreneurial skills | 60 | 6 |
| ENG/CU/ME/BC/05/4/A | Employability skills | 30 | 3 |
| ENG/CU/ME/BC/06/4/A | Environmental literacy | 20 | 2 |
| ENG/CU/ME/BC/07/4/A | Occupational safety and health practices | 20 | 2 |
| **Total** | | **210** | **21** |

**Common Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/ME/CC/01/4/A | Basic technical drawing | 30 | 3 |
| ENG/CU/ME/CC/02/4/A | Metallic and non-metallic materials | 30 | 2 |
| ENG/CU/ME/CC/03/4/A | Bench work operations | 60 | 6 |
| **Total** | | **110** | **11** |

**Core Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/ME/CR/01/4/A | Sheet metal fabrication | 200 | 20 |
| ENG/CU/ME/CR/02/4/A | Grinding Machine operation | 200 | 20 |
|  | Industrial Attachment | 300 | 30 |
| **Total** | | **700** | **70** |
| **Grand Total** | | **1020** | **102** |

The core units of learning are independent of each other and may be taken independently.

The total duration of the course is **1020 Hours** inclusive of industrial attachment.

**Entry Requirements**

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

1. Kenya Certificate of Secondary Education (K.C.S.E.)

**Or**

1. Related course with **one** year of continuous work experience

**Or**

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

**Industrial attachment**

An individual enrolled in this course will be required to undergo an industrial attachment in a Mechanical Engineering firm for a period of at least 300 hours. Attachment will be undertaken upon completion of the course or the unit of learning.

**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**

A candidate will be issued with a Certificate of Competency on demonstration of competence in a unit of competency. To attain the qualification Mechanical production (Grinding and Fabrication) Level 4, the candidate must demonstrate competence in all the units of competency as given in qualification pack.

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

**BASIC UNITS OF LEARNING**

**COMMUNICATION SKILLS**

**UNIT CODE:** ENG/CU/ME/BC/01/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate communication skills

**Duration of Unit:** 20 Hours

**Unit Description**

This unit describes the competencies required to lead in the dissemination and discussion of ideas, information and issues in the workplace.

**Summary of Learning Outcomes**

1. Obtain and convey workplace information
2. Complete relevant work-related documents
3. Communicate information about workplace processes
4. Lead workplace discussion
5. Identify and communicate issues arising in the workplace

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Obtain and convey workplace information | * Communication process * Modes of communication * Medium of communication * Effective communication * Barriers to communication * Flow of communication * Sources of information * Types of questions * Organizational policies * Workplace etiquette * Ethical work practices in handling communication | * Observation * Interview * Third party reports |
| 1. Complete relevant work-related documents | * Types and purposes of workplace documents and forms * Methods used in filling forms and documents * Recording workplace data * Process of distributing workplace forms and documents * Report writing * Types of workplace reports | * Observation * Interview * Third party reports |
| 1. Communicate information about workplace processes | * 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 | * Observation * Interview * Portfolio |
| 1. Lead workplace discussion | * Methods of discussion e.g.   + Coordination meetings   + Toolbox discussion   + Peer-to-peer discussion * Solicitation of response | * Observation * Interview * Third party reports |
| 1. Identify and communicate issues arising in the workplace | * Identification of problems and issues * Organizing information on problems and issues * Relating problems and issues * Communication barriers affecting workplace discussions | * Observation * Interview * Portfolio |

**Suggested Delivery Methods**

* Discussion
* Role play
* Brainstorming

**Recommended Resources**

* Desktop computers/laptops
* Internet connection
* Projectors
* Telephone
* Report writing templates

**NUMERACY SKILLS**

**UNIT CODE:** ENG/CU/ME/BC/02/4/A

**Relationship to Occupational Standards:**

This unit addresses the unit of competency: Demonstrate numeracy skills

**Duration of Unit:** 25hours

**Unit Description**

This unit describes the competencies required by a worker in order to competently Identify and use whole numbers and simple fractions, decimals and percentages; Identify, measure and estimate familiar quantities for work, Read and use familiar maps, plans and diagrams for work, Identify and describe common 2D and some 3D shapes for work, Construct simple tables and graphs for work using familiar data, Identify and interpret information in familiar tables, graphs and charts for work.

**Summary of Learning Outcomes**

1. Identify and use whole numbers and simple fractions, decimals and percentages for work

2. Identify, measure and estimate familiar quantities for work

3. Read and use familiar maps, plans and diagrams for work

4. Identify and describe common 2D and some 3D shapes for work

5. Construct simple tables and graphs for work using familiar data

6. Identify and interpret information in familiar tables, graphs and charts for work

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify and use whole numbers and simple fractions, decimals and percentages for work | * Whole numbers * Simple fractions * Decimals * Percentages * Sizes * Problem solving methods * calculations using the 4 operations * Recording and communicating numerical information | * Oral * Written * Practical test * Observation |
| 2. Identify, measure and estimate familiar quantities for work | * Measurement information * Units of measurement * Estimate familiar and simple amounts * Selection of appropriate measuring equipment * Calculate using familiar units of measurement * Check measurements and results against estimates * Using informal and some formal mathematical and general language * Record or report results | * Oral * Written * Practical test * Observation |
| 3. Read and use familiar maps, plans and diagrams for work | * Maps, plans and diagrams * Locate items and places in familiar maps, plans and diagrams * Recognize common symbols and keys in familiar maps, plans and diagrams * Direction and location of objects, or route or places * Use of informal and some formal oral mathematical language and symbols | * Oral * Written * Practical test * Observation |
| 4. Identify and describe common 2D and some 3D shapes for work | * Common 2D shapes and 3D shapes * Classification of common 2D shapes and designs * Description of Use informal and some formal language to describe common two-dimensional shapes and some common three-dimensional shapes * Construction of common 2D shapes * Match common 3D shapes to their 2D sketches or nets | * Oral * Written * Practical test * Observation |
| 5. Construct simple tables and graphs for work using familiar data | * Types of graphs * Determination of data to be collected * Selection of data collection method * Collection of data * Determination of variables from the data collected * Order and collate data * Construct a table and enter data * Construct a graph using data from table * Check results * Report or discuss graph information related to work using informal and some formal mathematical and general language | * Oral * Written * Practical test * Observation |
| 6. Identify and interpret information in familiar tables, graphs and charts for work | * Tables construction and labeling * i.e. title, headings, rows and columns * Interpreting information and data in simple tables * Relaying information of relevant workplace tasks on/in a table * Identify familiar graphs and charts in familiar texts and contexts * Locate title, labels, axes, scale and key from familiar graphs and charts * Identify and interpret information and data in familiar graphs and charts * Relate information to relevant workplace tasks | * Oral * Written * Practical test * Observation |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Practical demonstration of tasks by trainer
* Practice by trainees/ role play
* Discussion
* Observations and comments and corrections by trainers

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Mathematical tables

**DIGITAL LITERACY**

**UNIT CODE:** ENG/CU/ME/BC/03/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate digital literacy

**Duration of Unit:** 35 hours

**Unit Description**

This unit covers the competencies required to effectively demonstrate digital literacy in a working environment. It entails identifying and using digital devices such as smartphones, tablets, laptops and desktop PCs for purposes of communication and performing work related tasks at the work place.

**Summary of Learning Outcomes**

1. Identify computer hardware and software
2. Apply security measures to data, hardware and software
3. Apply computer software in solving tasks
4. Apply internet and email in communication at workplace

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify computer hardware and software | * Meaning of a computer * Functions of a computer * Components of a computer * Classification of computers | * Written * Oral * 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 | * Written tests * Oral presentation * Observation * Projects |
| 1. Apply computer software in solving tasks | * Operating system * Word processing * Spread sheets * Data base | * Oral questioning * Observation * Project |
| 1. Apply internet and email in communication at workplace | * Computer networks * Uses of internet * Electronic mail (e-mail) concept | * Oral questioning * Observation * Oral presentation * Written report |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practical work by trainee
* Viewing of related videos
* Project
* Group discussions

**Recommended Resources**

* Desk top computers
* Laptop computers
* Other digital devices
* Printers
* Storage devices
* Internet access
* Computer software

**ENTREPRENEURIAL SKILLS**

**UNIT CODE:** ENG/CU/ME/BC/04/4/A

**Relationship to occupational standards**

This unit addresses the unit of competency: Demonstrate entrepreneurial skills

**Duration of unit:** 60 hours

**Unit description**

This unit describes the competencies critical to demonstration of entrepreneurial skills. It includes creating and maintaining small scale business, establishing small scale business customer base, managing and growing a small business.

**Summary of Learning Outcomes**

1. Create and maintain small scale business
2. Establish small scale business customer base
3. Manage small scale business
4. Grow/ expand small scale business

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Create and maintain small scale business | * Starting a small business * Legal regulatory requirements in starting a small business * SWOT/ PESTEL analysis * Conducting market/industry survey * Generation and evaluation of business ideas * Matching competencies with business opportunities * Forms of business ownership * Location of a small business * Legal and regulatory requirement * Resources required to start a small business * Common terminologies in entrepreneurship * Entrepreneurship in national development * Self-employment * Formal and informal employment * Entrepreneurial culture * Myths associated with entrepreneurship * Types, characteristics, qualities & role of entrepreneurs * History, development and importance of entrepreneurship * Theories of entrepreneurship * Quality assurance for small businesses * Policies and procedures on occupational safety and health and environmental concerns | * Observation * Case studies * Individual/group assignments * projects * Written * Oral |
| 1. Establish small scale business customer base | * Good staff/workers and customer relations * Marketing strategy * Identifying and maintain new customers and markets * Product/ service promotions * Products / services diversification * SWOT / PESTEL analysis * Conducting a business survey * Generating Business ideas * Business opportunities | * Observation * Case studies * Individual/group assignments * projects * Written * Oral |
| 1. Manage small scale business | * Organization of a small business * Small business’ business plan * Marketing for small businesses * Managing finances for small business * Production/ operation process for goods/services * Small business records management * Book keeping and auditing for small businesses * Business support services * Small business resources mobilization and utilization * Basic business social responsibility * Management of small business * Word processing concepts in small business management * Computer application software * Monitoring and controlling business operations | * Oral * Observation * Case studies * Individual/group assignments * projects * Written |
| 1. Grow/expand small scale business | * Methods of growing small business * Resources for growing small business * Small business growth plan * Computer software in business development * ICT and business growth | * Observation * Case studies * Individual/group assignments * projects * Written |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practice by trainee
* Role play
* Case study

**Recommended Resources**

* Case studies for small businesses
* Business plan templates
* Lap top/ desk top computer
* Internet
* Telephone
* Writing materials

**EMPLOYABILITY SKILLS**

**UNIT CODE:** ENG/CU/ME/BC/05/4/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate employability skills

**Duration of Unit:** 30 hours

**Unit Description**

This unit covers competencies required to demonstrate employability skills. It involves conducting self-management, demonstrating critical safe work habits, demonstrating workplace learning and workplace ethics.

**Summary of Learning Outcomes**

1. Conduct self-management
2. Demonstrate critical safe work habits
3. Demonstrate workplace learning
4. 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 * 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 | * Observation * Written * Oral interview * Third party report |
| 1. Demonstrate critical safe work habits | * Stress and stress management * Punctuality and time consciousness * Interpersonal communication * Sharing information * Leisure * Integratingpersonal objectives into organizational objectives * Resources utilization * Setting work priorities * HIV and AIDS * Drug and substance abuse * Handling emerging issues | * Observation * Written * Oral interview * Third party report |
| 1. Demonstrate workplace learning | * Personal training needs identification and assessment * 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 * Workplace innovation * Performance improvement * Handling emerging issues * Future trends and concerns in learning | * Observation * Oral interview * Written * 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 | * Observation * Oral interview * Written * Third party report |

**Suggested Methods of Delivery**

* Instructor lead facilitation of theory
* Demonstrations
* Simulation/Role play
* Group Discussion
* Presentations
* Projects
* Case studies
* Assignments

**Recommended Resources**

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

**ENVIRONMENTAL LITERACY**

**UNIT CODE:** ENG/CU/ME/BC/06/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate environmental literacy

**Duration of Unit:** 20hours

**Unit Description**

This unit describes the competencies required to control environmental hazard, control environmental pollution, comply with workplace sustainable resource use and evaluate current practices in relation to resource usage.

**Summary of Learning Outcomes**

1. Control environmental hazard
2. Control environmental Pollution
3. Demonstrate sustainable resource use
4. Evaluate current practices in relation to resource usage

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Control environmental hazard | * 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 questions * Oral questions * Observation of work procedures |
| 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 questions * Oral questions * Observation of work procedures * Role play |
| 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 questions * Oral questions * Observation of work procedures * Role play |
| 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 questions * Oral questions * Observation of work procedures * Role play |
| 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 of work procedures |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Practical demonstration of tasks by trainer
* Practice by trainees/ role play
* Discussion
* Observations and comments and corrections by trainers

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Solid Waste Act
* Environmental Management and Coordination Act 1999
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE)

**OCCUPATIONAL SAFETY AND HEALTH PRACTICES**

**UNIT CODE:** ENG/CU/ME/BC/07/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate Safety and Health Practices

**Duration of Unit:** 20 hours

**Unit Description**

This unit describes the competencies required to practice safety and health, and comply with OSH requirements relevant to work.

**Summary of Learning Outcomes**

1. Observe workplace procedures for hazards and risk prevention
2. Participate in arrangements for workplace safety and health maintenance

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment**  **Methods** |
| 1. Observe workplace procedures for hazards and risk prevention | * Arrangement of work area and items in accordance with Company housekeeping procedures * Adherence to work standards and procedures * Application of preventive and control measures, including use of safety gears/PPE * Study and apply standards and procedures for incidents and emergencies. | * Oral questions * Written questions * Observation of work procedures |
| 1. Participate in arrangements for workplace safety and health maintenance | * Participating in orientations on OSH requirements/regulations of tasks * Providing feedback on health, safety, and security concerns to appropriate personnel as required in a sufficiently detailed manner * Practice workplace procedures for reporting hazards, incidents, injuries and sickness * OSH requirements/ regulations and workplace safety and hazard control procedures are reviewed, and compliance reported to appropriate personnel * Identification of needed OSH-related trainings are proposed to appropriate personnel | * Oral questions * Written tests * Practical test * Observation of practical work by trainees |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Practical demonstration of tasks by trainer
* Practice by trainees/ role play
* Discussion
* Observations and comments and corrections by trainers

**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 bootsn
* 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

**BASIC TECHNICAL DRAWING**

**UNIT CODE:** ENG/CU/ME/CC/01/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: interpret basic technical drawings

**Duration of Unit:** 30hours

**Unit Description**

This unit covers the competencies required by a mechanical production artisan to interpret basic technical drawings. It involves competencies to: select and use drawing instruments and materials, interpret plain geometry drawings, solid geometry drawings, pictorial and orthographic drawings and mechanical drawings to help in grinding and fabrication of components.

**Summary of Learning Outcomes**

1. Use drawing instruments and materials
2. Interpret plane geometry drawings
3. Interpret solid geometry drawings
4. Interpret orthographic and pictorial drawings
5. Produce mechanical drawings

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Use drawing instruments and materials | * Identification and care of drawing equipment and materials * Reference to manufacturer’s instructions and work place procedures on use and maintenance of drawing equipment and materials * Reference to relevant environmental legislations * Use of Personal Protective Equipment (PPEs) | * Written test * Observation * Oral questioning |
| 1. Interpret plane geometry drawings | * Types of lines in drawings * Construction of geometric forms e.g. squares, circles, polygons * Construction of different angles * Measurement of different angles * Bisection of different angles and lines * Standard drawing conventions * Free hand sketching of geometric forms | * Written test * Observation * Oral questioning |
| 1. Interpret solid geometry drawings | * Interpretation of sketches and drawings of patterns e.g. prisms, cones. pies, frustrum and pyramids * Sectioning of solids e.g. prisms, cones * Development and interpenetrations of solids e.g. cylinder to cylinder and cylinder to triangular, prism | * Written test * Observation * Oral questioning |
| 1. Interpret orthographic and pictorial drawings | * Meaning of orthographic drawings * Meaning of sectioning * Meaning of symbols and abbreviations * Drawing and interpretation of orthographic elevations * Dimensioning of orthographic elevations * Sectioning of views * Meaning of pictorial drawings * Drawing objects in isometric view * Drawing objects in oblique view | * Written test * Observation * Oral questioning |
| 1. Produce mechanical drawings | * Mechanical symbols and abbreviations * Meaning of mechanical drawings * Drawing of mechanical diagrams   + Block   + Line   + Schematic | * Written test * Observation * Oral questioning |

**Suggested Delivery Methods**

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

**Recommended Resources**

* Drawing room
* Drawing instruments e.g. T-squares, set squares, drawing sets
* Drawing tables
* Pencils, papers, erasers
* Masking tapes
* Teaching models
* Calculators

# METALLIC AND NON-METALLIC MATERIALS

**UNIT CODE:** ENG/CU/ME/CC/02/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Use common metallic and non-metallic materials **Duration of Unit:** 30 hours

**Unit Description:**

This unit covers the unit of competency required by a mechanical production artisan to use common metallic and non-metallic materials. It involves competencies required to: identify properties of engineering materials, identify ore extraction processes, identify methods of producing engineering materials, perform heat treatment and prevent material corrosion.

**Summary of Learning Outcomes**

1. Identify properties of engineering materials
2. Identify ore extraction processes of metallic materials
3. Identify methods of producing materials
4. Perform heat treatment
5. Prevent material corrosion

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * 1. Identify properties of engineering materials | * + Engineering materials are identified as per the applications   + Physical properties of engineering material   + Mechanical properties of engineering materials   + Chemical Properties of engineering materials * Crystal structure of materials | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 1. Identify ore extraction processes of metallic materials | * Safety measures in metal extraction * Methods of metal extraction * Reduction by Electrolysis * Reduction by carbon * Reduction by more reactive metals * Procedure in metal extraction processes * Extraction by-products   + Storing of metals Extraction by- products   + Disposing extraction by- products | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 1. Identify methods of producing engineering materials | * Types of materials * Metallic * Ferrous * Non-ferrous * Alloys * Non- Metallic * Ceramics * Wood * Plastics * Composite * Rubber * Methods of material production and testing * Forms of supply of engineering materials * Finishing and Refinement processes of various types of materials   + - Lapping     - Fine grinding     - Polishing | * Assignments * Oral questioning * Supervised exercises * Written tests |
| 1. Perform heat treatment | * + Safety procedures   + Tools and equipment in heat treatment   + Heat treatment processes * Annealing * Tempering * Normalizing * Hardening * Case hardening   + Procedure in heat treatment processes | * Assignments * Supervised exercises * Written tests * Practical test |
| 1. Prevent material corrosion | * Safety observation during corrosion prevention * Agents of corrosion * Causes of corrosion * Methods of corrosion prevention Corrosion prevention * Painting * Plating * Electroplating * Galvanizing * Cathodic * Chromizing | * Assignments * Supervised exercises * Written tests * Practical test |

**Suggested Delivery Methods**

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

**List of Recommended Resources**

**Recommended Resources**

Tools and equipment

* Heat treatment equipment (furnaces, oxy-fuel gas system etc)
* Material testing equipment
* Measuring tools and gauges
* Marking out tools
* Inspection tools and equipment
* Dressing tools
* Firefighting equipment

**Materials and supplies**

* PPEs –dust coat, dust masks, ear muffs, goggles
* First Aid kit
* Brooms and cleaning stuff
* Cleaning detergents
* Drawing papers

# BENCH WORK OPERATIONS

**UNIT CODE:** ENG/CU/ME/CC/03/4/A

**Relationship to Occupational Standards**:

This unit addresses the unit of competency: Perform bench work operations

Duration of Unit: 60 Hours

**Unit description**

The Mechanical production artisan will be able to perform bench work operations using basic hand tools while observing occupational safety and health legislations, regulations and safe working practices. In the context of the standards, the learner is to plan work operations, mark out work pieces, set up work pieces on holding devices, assemble metal parts and their sub-assemblies, inspect the work for accuracy and organize the work area.

**Summary of Learning Outcome**

1. Observe safety rules and regulations
2. Plan work operations
3. Mark out dimensions on work pieces
4. Set up work pieces on holding devices
5. Use hand tools
6. Use bench drill
7. Assemble metal parts and sub-assemblies
8. Inspect finished work
9. Maintain hand tools and equipment
10. Perform housekeeping

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Observe safety rules and regulations | * Occupational safety health and regulations (OSHA) * Personal protective equipment * Machine safety * Environmental safety | * Administration of written and oral tests * Assessment of worksheet/ operation plans |
| 1. Plan work operations | * Work operation plan procedure * Time management * Work scheduling. * Selection of tools as per the specific operation * Selection of material for the given component | * Observation * Administration of oral and written questions |
| 1. Mark out dimensions on work pieces | * Measuring tools   + Inspection   + calibration * Marking tools * use of marking out tools * Laying out work piece(s) * Transfer of dimensions onto the work piece(s) | * Observation of laying out of work piece(s) * Assessment of transferred dimensions * Administration of oral and written questions |
| 1. Set up work pieces on holding devices | * Work holding devices   + Bench vice   + V-Block   + Angle plate   + G-clamp   + Jigs and fixtures   + Hand vice * Methods of Setting up work pieces. | * Observation * Written assessment * Oral questioning |
| 1. Use hand tools | * Hand tools   + Files   + Hacksaw   + Hammers   + Chisels   + Taps and dies   + Marking out tools   + Measuring tools * Quality specifications   + Dimensions   + Tolerances   + Geometry   + Surface finish   + Functionality | * Observation * Written assessment * Oral assessment * Practical projects |
| 1. Use bench drill | * Marking hole center * Types of drill bits * Drill machine work holding devices * Drilling operations   + Counter sinking   + Counter boring   + Reaming   + Boring | * Observation * Written assessment * Oral questioning * Practical projects |
| 1. Assemble metal parts and sub-assemblies | * Parts joining methods   + Riveting   + Use of mechanical fasteners   + Use of adhesives   + Soldering   + Brazing   + Welding | * Observation * Written assessment * Oral questioning * Practical project |
| 1. Inspect finished work | * Inspection tools * Inspection methods | * Observation * Written assessment * Oral questioning |
| 1. Maintain hand tools and equipment | * Servicing and maintenance * Alignment * Adjustment * Cleaning * Oiling * Painting * Basic inspection * Storage | * Written assessment * Oral questioning * Observation of clean working environment * Observation |
| 1. Perform housekeeping | * Cleaning of work environment (waste sorting and disposal) * Cleaning and storing of tools and equipment | * Written assessment * Oral questioning * Observation of clean working environment * Observation |

**Suggested Delivery Methods**

* Demonstration by trainer
* Discussions
* Projects
* Practical work by trainee(s)
* Exercises
* Industrials visits
* Internet simulation

**List of Recommended Resources**

**Tools and equipment suggested but not limited to:**

* Welding
* Drilling machines
* Vices
* Cutting tools
* Combination square
* Centre punch
* Centre lathe
* Scribers
* Calipers
* Dies and taps
* Surface plate
* V-blocks
* Dial gauge
* Die stock
* Engineer’s square
* File card
* Assorted Files
* Clamps
* Assorted hand tools
* Hammers
* Measuring tools
* Drill bits
* Assorted inspection tools and equipment
* Inspection and measuring tools, GO and NOT GO gauges
* Jigs and fixture
* Pliers
* Rotary disc abrasive grinder
* Reamers
* Saw
* Screwdrivers
* Spiral lowering
* Tap wrench
* Vacuum cleaners
* V-block
* Workbenches
* Firefighting equipment
* First Aid kit

**Materials and supplies suggested but not limited to:**

* Personal safety gear:
* Goggles
* Safety shoes
* Overall
* Cap
* Ear Muffs
* Gloves
* Drawing papers
* Raw materials
* Mild steel plate
* Sheet metal
* Brass sheets
* Zinc sheets
* Aluminum sheets
* Bright Drawn Mild Steel
* Carbon steel
* Brass rods
* Aluminum rods
* Abrasive materials
* Grinding paste
* Cotton wastes
* Cleaning detergents
* Vacuum cleaners
* Mops/ Brooms and buckets

# CORE UNITS OF LEARNING

SHEET METAL FABRICATION

**UNIT CODE:** ENG/CU/ME/CR/01/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Fabricate sheet metal parts

**Duration of Unit:** 200 hours

**Unit Description**

This unit covers the competencies required by a Mechanical production (Grinding and Fabrication Operations) artisan to fabricate sheet metal parts. It includes competencies that ensure the learner will: observe safety rules and regulations, identify sheet metal tools & Equipment, read and interpret working drawing, mark out, set up sheet metal fabrication machines and equipment, fabricate sheet metal components, assess quality of components, maintain sheet metal fabrication tools, machine and equipment and perform housekeeping

.

**Summary of Learning Outcomes**

1. Observe safety rules and regulations
2. Use sheet metal machines, tools & equipment.
3. Plan work operation
4. Mark out work pieces
5. Set- up sheet metal machine
6. Fabricate sheet metal parts
7. Inspect finished work piece
8. Maintain sheet metal machines, tools and equipment
9. Perform housekeeping
10. Prepare reports

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Observe safety rules and regulations | * Personal safety, PPEs worn in accordance to the work environment * Safety regulations on OSHA * Observation of safe working environment * Adherence to workplace procedures and environmental measures | * Oral questions * Written tests * Observation of trainees identify hazards and risks |
| 1. Use sheet metal machines, tools & equipment. | * Types of sheet metal machine tools / equipment * Parts of sheet metal machine tools/ equipment and their functions | * Oral questions * Written tests * Practical test * Observation of implementation of control measures |
| 1. Plan work operation | * Work operation plan procedure * Time management * Work scheduling. * Selection of tools as per the specific operation * Selection of material for the given component | * Oral questions * Written tests * Practical test * Observation |
| 1. Mark out workpieces | * Selection of measuring and marking out tools * Dimensional specifications * Marking out | * Oral questions * Written tests * Practical test * Observation |
| 1. Set- up sheet metal machine | * Machine tools selection * Mounting of machine attachments | * Oral questions * Written tests * Practical test * Observation |
| 1. Fabricate sheet metal parts | * Production of sheet metal work pieces * Sheet metal joining methods * Soldering * Welding * Manual Metal Arc Welding * Gas Welding * Resistance/ Spot Welding * Riveting * Brazing * Mechanical fasteners | * Oral questions * Written tests * Practical test * Observation |
| 1. Inspect finished workpiece | * Cleaning methods of the finished workpiece * Inspection methods of the finished workpiece | * Oral questions * Written tests * Practical test * Observation |
| 1. Maintain sheet metal machines, tools and equipment | * Cleaning of the machine tools and equipment after the work * Inspection of machine tools and equipment after the work * Fault identification and reporting * Lubrication of the machine tools/equipment & accessories | * Oral questions * Written tests * Practical test * Observation |
| 1. Perform housekeeping | * Work place cleaning procedures * Waste segregation and disposal * Storage of tools and equipment | * Oral questions * Written tests * Practical test * Observation |
| 1. Prepare Reports | * Defects/ deviations report * Cost variations report * Accidents and incidents reports | * Oral questions * Written tests * Practical test * Observation |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practical work by trainee
* Field trips
* 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 shield
* Safety boots
* Safety harness
* Arm/Hand guard, gloves
* Eye protection (goggles, shield)
* Hearing protection (ear muffs, ear plugs)
* Hair Net/cap/bonnet
* Head helmet
* Apron/Gown/overall/jump suit
* Anti-static suits
* High-visibility reflective vest

# GRINDING MACHINE OPERATIONS

**UNIT CODE:** ENG/CU/ME/CR/02/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform grinding operations

**Duration of Unit:** 200 hours

**Unit Description**

This unit covers the competencies required to perform grinding operations. Competencies includes: observing safety rules and regulations, identification of types of grinding machines and parts of grinding machines, demonstration of working principles of operations, identification of grinding operations, preparation of work piece, inspection of the finished work, and maintenance of the grinding machine and accessories.

**Summary of Learning Outcomes**

1. Observe safety rules and regulations
2. Identify grinding machine tools.
3. Identify grinding wheels
4. Plan work operation
5. Set- up the grinding machine
6. Perform grinding operations
7. Inspect finished work piece
8. Maintain the grinding machine
9. Perform Housekeeping
10. Prepare reports

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * 1. 1. Observe safety rules and regulations | * Personal safety, PPEs in accordance to the work environment * Grinding machine tools safety precautions * Safety regulations on OSHA * Adherence to workplace procedures and environment measures | * Oral questions * Written tests * Observation |
| * 2. Identify grinding machine tools | * Types of grinding machine tools / equipment * Parts of grinding machine tools/ equipment and their functions * Grinding machine tools / equipment selection and usage. | * Oral questions * Written tests * Practical test * Observation of implementation of control measures |
| 3. Identify grinding wheels | * Wheel dressing * Types of grinding wheels/stones * Classification of grinding wheels/ stones and their defects * Grinding wheels calculation and geometry * Grinding wheel balancing * Abrasive principle and material identification | * Oral questions * Written tests * Practical test * Observation |
| 1. Plan work operation | * Work operation plan procedure * Time management * Work scheduling. * Selection of tools as per the specific operation * Selection of material for the given component | * Oral questions * Written tests * Practical test * Observation |
| 1. Set- up the grinding machine | * Wheel/stones selection and mounting * Work piece securing/mounting | * Oral questions * Written tests * Practical test * Observation |
| 1. Perform grinding operations | * Principle of operation * Grinding operation * Surface grinding * Portable grinding machine operation | * Oral questions * Written tests * Practical test * Observation |
| 1. Inspect finished work piece | * Dimensional accuracy analysis * Surface finish checks * Functionality checks * Inspection of the finished work piece | * Oral questions * Written tests * Practical test * Observation |
| 1. Maintain the grinding machine | * Cleaning of the machine tools and equipment after the work * Inspection of machine tools and equipment after the work * Lubrication of the machine tools/equipment & accessories | * Oral questions * Written tests * Practical test * Observation |
| 1. Perform housekeeping | * Work place cleaning procedures * Waste segregation and disposal * Storage of tools and equipment | * Oral questions * Written tests * Practical test * Observation |
| 1. Prepare Reports | * Defects/ deviations report * Cost variations report * Accidents and incidents reports | * Oral questions * Written tests * Practical test * Observation |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practical work by trainee
* 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 shield
* Safety boots
* Safety harness
* Arm/Hand guard, gloves
* Eye protection (goggles, shield)
* Hearing protection (ear muffs, ear plugs)
* Hair Net/cap/bonnet
* Head helmet
* Apron/Gown/overall/jump suit
* Anti-static suits
* High-visibility reflective vest