

**REPUBLIC OF KENYA**

**COMPETENCY BASED CURRICULUM**

**FOR**

**MECHANICAL TECHNICIAN LEVEL 6**



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 (Sessional Paper No. 4 of 2016). A key feature of this policy is the radical change in the design and delivery of TVET training. This policy document requires that training in TVET be competency based, curriculum development be industry led, certification be based on demonstration of competence and 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 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 and Sessional Paper No. 4 of 2016 on Reforming Education and Training in Kenya, emphasized the need to reform curriculum development, assessment and certification. This called for a shift to CBET in order to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labor force.

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. EngTech.**

**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 Mechanical Engineering Sector Skills Advisory Committee (SSAC) members for their contribution to the development of this curriculum.

I also thank all stakeholders in the 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 production acquire competencies that will enable them to perform their work more efficiently.

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

**COUNCIL SECRETARY/CEO**

# KEY TO UNIT CODE

**ENG/OS/ET/BC/01/6/A**

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

Control Version

# ACRONYMNS AND ABBREVIATIONS

|  |  |  |
| --- | --- | --- |
|  |  |  |
| CDACC |  | Curriculum Development, Assessment and Certification Council |
| ISO |  | International Organization for Standardization |
| K.C.S.E |  | Kenya Certificate of Secondary Education |
| KNQA |  | Kenya National Qualification Authority |
| KNQF |  | Kenya National Qualification Framework |
| OHSAS |  | Occupational Health and Safety Assessment Series |
| PPE |  | Personal Protective Equipment |
| QMS |  | Quality Management System |
| SOP |  | Standard Operating Procedures |
| TQM |  | Total Quality Management |
| TVET |  | Technical and Vocational Education and Training |

# OVERVIEW

This course is designed to equip the Mechanical Production Technician with the competencies to produce subassemblies or final assemblies by setting up and operate production equipment, using good manufacturing practices and standard operating procedures.

The Mechanical Production Technician assist engineers in developing, building, or testing prototypes or new products, processes, or procedure assist and monitor and adjust production processes or equipment for quality and productivity

This course consists of basic and core units of learning as indicated below:

**Basic Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning Code** | **Unit of Learning**  **Title** | **Duration in Hours** | **Credit factor** |
| ENG/CU/ME/BC/1/06/A | Demonstrate  communication  skills | 40 | 4 |
| ENG/CU/ME/BC/2/06/A | Demonstrate digital literacy | 80 | 8 |
| ENG/CU/ME/BC/3/06/A | Demonstrate entrepreneurial skills | 80 | 8 |
| ENG/CU/ME/BC/4/06/A | Demonstrate employability skills | 60 | 6 |
| ENG/CU/ME/BC/5/06/A | Demonstrate environmental literacy | 40 | 4 |
| ENG/CU/ME/BC/6/06/A | Demonstrate occupational safety | 50 | 5 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | and health practices |  |  |
| **TOTAL** | | **350** | **35** |

**Common Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning Code** | **Unit of Learning**  **Title** | **Duration in Hrs.** | **Credit factor** |
| ENG/CU/ME/CC/1/06/A | Technical drawings | 150 | 15 |
| ENG/CU/ME/CC/2/06/A | Engineering Mathematics | 150 | 15 |
| ENG/CU/ME/CC/3/06/A | Mechanical Principle skills | 75 | 7.5 |
| ENG/CU/ME/CC/4/06/A | Fluid mechanics principles | 75 | 7.5 |
| ENG/CU/ME/CC/5/06/A | Thermodynamics principles | 75 | 7.5 |
| ENG/CU/ME/CC/6/06/A | Material science and  perform metallurgical processes | 75 | 7.5 |
| **TOTAL** | | **600** | **60** |

**Core Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning**  **Code** | **Unit of Learning**  **Title** | **Duration in Hrs.** | **Credit factor** |
| ENG/CU/ME/CR/1/06/A | Produce parts by bench work | 150 | 15 |
| ENG/CU/ME/CR/2/06/A | Lathe work | 100 | 10 |
| ENG/CU/ME/CR/3/06/A | Sheet metal parts | 140 | 14 |
| ENG/CU/ME/CR/4/06/A | Join parts by manual arc welding | 140 | 14 |
| ENG/CU/ME/CR/5/06/A | Milling work | 140 | 14 |
| ENG/CU/ME/CR/6/06/A | Produce parts by grinding machine  tool | 100 | 10 |
| ENG/CU/ME/CR/7/06/A | Perform workshop  processes | 100 | 10 |
| ENG/CU/ME/CR/8/06/A | Manage mechanical workshop | 100 | 10 |
|  | Industrial Attachment | 480 | 48 |
| **TOTAL** | | **1450** | **145** |
| **GRAND TOTAL** | | **2400** | **240** |

**1. 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.) with a minimum mean grade of C- (C minus)

**Or**

1. Mechanical Engineering Technician Level 5 certificate with **one** year of continuous work experience

**Or**

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

1. **Provision for Industrial attachment**

It is envisaged that the trainee will have undergone an industrial training and assessment with a recognized workplace as a prerequisite for completion of this training course and show evidence.

1. **Assessment**

The course will be assessed at two levels: internally and externally. Internal assessment is continuous and is conducted by the trainer who is monitored by an internal accredited verifier while external assessment is the responsibility of TVET CDACC.

As part of the continuous internal assessment process, trainees will maintain a portfolio of evidence of their achievements.

1. **Certification**

On successful completion of a Unit of Learning, a trainee will be issued with a Certificate that acknowledges the achievement of that competence. On successful completion of **all** units of learning, a trainee will be awarded Mechanical Technician Diploma qualification (Production). These certificates will be issued by TVET CDACC in conjunction with training provider.

# BASIC UNITS OF LEARNING

# COMMUNICATION SKILLS

**UNIT CODE: UNIT CODE: ENG/CU/ME/BC/1/06/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate communication skills

**Duration of Unit:** 40 hours

**Unit Description**

This unit covers the competencies required in meeting communication needs of clients and colleagues and developing, establishing, maintaining communication pathways and strategies. It also covers competencies for conducting interview, facilitating group discussion and representing the organization in various forums.

**Summary of Learning Outcomes**

1. Meet communication needs of clients and colleagues
2. Develop communication strategies
3. Establish and maintain communication pathways
4. Promote use of communication strategies
5. Conduct interview
6. Facilitate group discussion
7. 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 * Types of communication strategies * Elements of communication strategy | * Interview * Written |
| 1. Develop communication strategies | * Dynamics of groups * Styles of group leadership * Openness and flexibility in communication * Communication skills relevant to client groups | * Interview * Written |
| 1. Establish and maintain communication pathways | * Types of communication pathways | * Interview * Written |
| 1. Promote use of communication strategies | * Application of elements of communication strategies * Effective communication techniques | * Interview * Written |
| 1. Conduct interview | * Types of interview * Establishing rapport * Facilitating resolution of issues * Developing action plans | * Interview * Written |
| 1. Facilitate group discussion | * Identification of communication needs * Dynamics of groups * Styles of group leadership * Presentation of information * Encouraging group members participation * Evaluating group communication strategies | * Interview * Written |
| 1. Represent the organization | * Presentation techniques * Development of a presentation * Multi-media utilization in presentation * Communication skills relevant to client groups | * Interview * Written |

**Suggested Delivery Methods**

* Discussion
* Role playing
* Simulation
* Direct instruction
* Practice by trainee

**Recommended Resources**

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

# NUMERACY SKILLS

**UNIT CODE: ENG/CU/ME/BC/2/06/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate numeracy skills

**Duration of Unit:** 60 hours

**Unit Description**

This unit describes the competencies required by a worker in order to apply a wide range of mathematical calculations for work; apply ratios, rates and proportions to solve problems; estimate, measure and calculate measurement for work; Use detailed maps to plan travel routes for work; Use geometry to draw and construct 2D and 3D shapes for work; Collect, organize and interpret statistical data; Use routine formula and algebraic expressions for work and use common functions of a scientific calculator

**Summary of Learning Outcomes**

1. Apply a wide range of mathematical calculations for work
2. Apply ratios, rates and proportions to solve problems
3. Estimate, measure and calculate measurement for work
4. Use detailed maps to plan travel routes for work
5. Use geometry to draw and construct 2D and 3D shapes for work
6. Collect, organize and interpret statistical data
7. Use routine formula and algebraic expressions for work
8. Use common functions of a scientific calculator

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply a wide range of mathematical calculations for work | * Fundamentals of mathematics * Addition, subtraction, multiplication and division of positive and negative numbers * Algebraic expressions manipulation * Forms of fractions, decimals and percentages * Expression of numbers as powers and roots | * Written tests * Assignments * Supervised exercises |
| 1. Apply ratios, rates and proportions to solve problems | * Rates, ratios and proportions * Meaning * Conversions into percentages * Direct and inverse proportions determination * Performing calculations * Construction of graphs, charts and tables * Recording of information | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. Estimate, measure and calculate measurement for work | * Units of measurements and their symbols * Identification and selection of measuring equipment * Conversion of units of measurement * Perimeters of regular figures * Areas of regular figures * Volumes of regular figures * Carrying out measurements * Recording of information | * Assignments * Supervised exercises * Written tests |
| 1. Use detailed maps to plan travel routes for work | * Identification of features in routine maps and plans * Symbols and keys used in routine maps and plans * Identification and interpretation of orientation of map to North * Demonstrate understanding of direction and location * Apply simple scale to estimate length of objects, or distance to location or object * Give and receive directions using both formal and informal language * Planning of routes * Calculation of distance, speed and time | * Oral * Written * Practical test * Observation |
| 1. Use geometry to draw and construct 2D and 3D shapes for work | * Identify two dimensional shapes and routine three dimensional shapes in everyday objects and in different orientations * Explain the use and application of shapes * Use formal and informal mathematical language and symbols to describe and compare the features of two dimensional shapes and routine three dimensional shapes * Identify common angles * Estimate common angles in everyday objects * Evaluation of unknown angles * Use formal and informal mathematical language to describe and compare common angles * Symmetry and similarity * Use common geometric instruments to draw two dimensional shapes * Construct routine three dimensional objects from given nets |  |
| 1. Collect, organize and interpret statistical data | * + Classification of data * Grouped data * Ungrouped data   + Data collection * Observation * Recording   + Distinguishing between sampling and census   + Importance of sampling   + Errors in sampling   + Types of sampling and their limitations e.g. * Stratified random * Cluster * Judgmental   + Tabulation of data * Class intervals * Class boundaries * Frequency tables * Cumulative frequency   + Diagrammatic and graphical presentation of data e.g. * Histograms * Frequency polygons * Bar charts * Pie charts * Cumulative frequency curves * Interpretation of data | * Assignments * Supervised exercises * Written tests |
| 1. Use routine formula and algebraic expressions for work | * + Solving linear equations   + Linear graphs * Plotting * Interpretation   + Applications of linear graphs * Curves of first and second degree * Plotting * Interpretation | * Assignments * Supervised exercises * Written tests |
| 8. Use common functions of a scientific calculator | * Identify and use keys for common functions on a calculator * Calculate using whole numbers, money and routine decimals and percentages * Calculate with routine fractions and percentages * Apply order of operations to solve multi-step calculations * Interpret display and record result | * Oral * Written * Practical test * Observation |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Practical work by trainee
* Exercises

**Recommended Resources**

* Calculators
* Rulers, pencils, erasers
* Charts with presentations of data
* Graph books
* Dice

# DIGITAL LITERACY

**UNIT CODE: ENG/CU/ME/BC/3/06/A**

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate digital literacy

**Duration of Unit:** 60 hours

**Unit Description**

This unit describes competencies required to use a computer and other digital devices for the purposes of communication, work performance and management at the workplace.

**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 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

# ENTREPRENEURSHIP EDUCATION

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

**Relationship to occupational standards**

This unit addresses the unit of competency: Demonstrate understanding of entrepreneurship

**Duration of unit:** 100 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 who an entrepreneur
  2. Demonstrate knowledge of entrepreneurship and self-employment
  3. Identify entrepreneurship opportunities
  4. Create entrepreneurial awareness
  5. Apply entrepreneurial motivation
  6. Develop business innovative 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 | * Observation * Case studies * 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 | * Observation * Case studies * 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 | * Observation * Case studies * 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 | * Observation * 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 | * Observation * 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 | * Observation * Case studies * Individual/group assignments * Projects * Written tests * Oral questions * Third party report * Interviews |

**Suggested Methods of instruction:**

1. Direct instruction
2. Project
3. Case studies
4. Field trips
5. Discussions
6. Demonstration
7. Question and answer
8. Problem solving
9. Experiential
10. Internship
11. Team training
12. Guest speakers

**Recommended Resources**

1. Case studies
2. Business plan templates
3. Computers
4. Overhead projectors
5. Internet
6. Mobile phone
7. Video clips
8. Films
9. Newspapers and Handouts
10. Business Journals
11. Writing materials

# EMPLOYABILITY SKILLS

**UNIT CODE: ENG/CU/ME/BC/5/06/A**

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate employability skills

**Duration of Unit:** 80 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 ethical performance.

**Summary of Learning Outcomes**

1. Conduct self-management
2. Demonstrate interpersonal communication
3. Demonstrate critical safe work habits
4. Lead a workplace team
5. Plan and organize work
6. Maintain professional growth and development
7. Demonstrate workplace learning
8. Demonstrate problem solving skills
9. Manage ethical performance

**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 * Managing emotions * Emotional intelligence * Assertiveness versus aggressiveness * Expressing personal thoughts, feelings and beliefs * Developing and maintaining high self-esteem * Developing and maintaining positive self-image * Setting performance targets * Monitoring and evaluating performance * Articulating ideas and aspirations * Accountability and responsibility * Good work habits * Self-awareness * Values and beliefs * Self-development * Financial literacy * Healthy lifestyle practices * Adopting safety practices | * Observation * Written * Oral interview * Third party report |
| 1. Demonstrate interpersonal communication | * Meaning of interpersonal communication * Listening skills * Types of audience * Public speaking * Writing skills * Negotiation skills * Reading skills * Meaning of empathy * Understanding customers’ needs * Establishing communication networks * Assertiveness * Sharing information |  |
| 1. Demonstrate critical safe work habits | * Stress and stress management * Time concept * Punctuality and time consciousness * Leisure * Integratingpersonal objectives into organizational objectives * Resources mobilization * Resources utilization * Setting work priorities * Developing healthy relationships * HIV and AIDS * Drug and substance abuse * Managing emerging issues | * Observation * Written * Oral interview * Third party report |
| 1. Lead a workplace team | * Leadership qualities * Power and authority * Team building * Determination of team roles and objectives * Team parameters and relationships * Individual responsibilities in a team * Forms of communication * Complementing team activities * Gender and gender mainstreaming * Human rights * Developing healthy relationships * Maintaining relationships * Conflicts and conflict resolution * Coaching and mentoring skills | * Observation * Oral interview * Written * Third party report |
| 1. Plan and organize work | * Functions of management * Planning * Organizing * Time management * Decision making concept * Task allocation * Developing work plans * Developing work goals/objectives and deliverables * Monitoring work activities * Evaluating work activities * Resource mobilization * Resource allocation * Resource utilization * Proactive planning * Risk evaluation * Problem solving * Collecting, analysing and organising information * Negotiation | * Observation * Oral interview * Written * Third party report |
| 1. Maintain professional growth and development | * Avenues for professional growth * Training and career opportunities * Assessing training needs * Mobilizing training resources * Licenses and certifications for professional growth and development * Pursuing personal and organizational goals * Managing work priorities and commitments * Recognizing career advancement | * Observation * Oral interview * Written * Third party report |
| 1. Demonstrate workplace learning | * Managing own learning * Mentoring * Coaching * Contributing to the learning community at the workplace * Cultural aspects of work * Networking * Variety of learning context * Application of learning * Safe use of technology * Taking initiative/proactivity * Flexibility * Identifying opportunities * Generating new ideas * Workplace innovation * Performance improvement * Managing emerging issues * Future trends and concerns in learning | * Observation * Oral interview * Written * Third party report |
| 1. Demonstrate problem solving skills | * Critical thinking process * Data analysis tools * Decision making * Creative thinking * Development of creative, innovative and practical solutions * Independence in identifying and solving problems * Solving problems in teams * Application of problem-solving strategies * Testing assumptions * Resolving customer concerns | * Observation * Oral interview * Written * Third party report |
| 1. Manage ethical performance | * Meaning of ethics * Ethical perspectives * Principles of ethics * 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/6/06/A**

**Relationship to Occupational Standards:**

This unit addresses the unit standard: Demonstrate environmental literacy

Duration of Unit: 40 hours

**Unit Description**

This unit describes the competencies required to control environmental hazard, control environmental pollution, comply with workplace sustainable resource use, evaluate current practices in relation to resource usage, identify environmental legislations/conventions for environmental concerns, implement specific environmental programs, monitor activities on environmental protection/programs, analyze resource use and develop resource conservation plans.

**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
5. Identify Environmental legislations/conventions for environmental concerns
6. Implement specific environmental programs
7. Monitor activities on Environmental protection/Programs
8. Analyze resource use
9. Develop resource conservation plans

**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 * 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 |
| 1. Implement specific environmental programs | * Community needs and expectations * Resource availability * 5s of good housekeeping * Identification of programs/Activities * Setting of individual roles /responsibilities * Resolving problems /constraints encountered * Consultation with stakeholders | * Written questions * Oral questions * Observation of work procedures * Role play |
| 1. Monitor activities on Environmental protection/Programs | * Periodic monitoring and Evaluation of activities * Gathering feedback from stakeholders * Analyzing 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 |
| 1. Analyze resource use | * Identification of resource consuming processes * Determination of quantity and nature of resource consumed * Analysis of resource flow through different parts of the process. * Classification of wastes for possible source of resources. | * Written tests * Oral questions * Practical test * Observation |
| 1. Develop resource Conservation plans | * Determination of efficiency of use/conversion of resources * Causes of low efficiency of use of resources * Plans for increasing the efficiency of resource use | * Written tests * Oral questions * Practical test * Observation |

**Suggested Delivery Methods**

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

**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
* Company environmental management systems (EMS)
* Montreal Protocol
* Kyoto Protocol

# OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE: ENG/CU/ME/BC/7/06/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate occupational safety and health practices

Duration of Unit: 40 hours

**Unit Description**

This unit describes the competencies required to comply with regulatory and organizational requirements for occupational safety and health.

**Summary of Learning Outcomes**

1. Identify workplace hazards and risk
2. Identify and implement appropriate control measures to hazards and risks
3. Implement OSH programs, procedures and policies/guidelines

**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 * Gathering of OSH issues and/or concerns | * Oral questions * Written tests * Observation of trainees identify hazards and risks |
| 1. Identify and implement appropriate control measure to hazards and risks | * Prevention and control measures e.g. use of PPE * Contingency measures | * Oral questions * Written tests * Practical tests * Observation of implementation of control measures |
| 1. Implement OSH   programs, procedures  and policies/guidelines | * Company OSH program, procedures and policies/guidelines * 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 * 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 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/MPE/CC/01/6/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Prepare and interpret technical drawings

**Duration of Unit: 150 Hours**

**Unit Description**

This unit covers the competencies required to prepare and interpret technical drawings by a Plant technician. It involves competencies to select, use and maintain drawing equipment and materials. It also involves producing plain geometry drawings, solid geometry drawings, pictorial and orthographic drawings of components and application of CAD software.

**Summary of Learning Outcomes**

1. Use and maintain drawing equipment and materials
2. Produce plain geometry drawings
3. Produce solid geometry drawings
4. Produce pictorial and orthographic drawings of components
5. Apply CAD software

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Use and maintain drawing equipment and materials | * Identification and maintain of drawing equipment and materials * Identification and maintain of drawing materials | * Observation * Oral questioning * Written tests |
| 1. Produce plain geometry drawings | * Lettering in drawing * Types of lines in drawings * Construction of geometric forms * Construction of different angles * Measurement of different angles * Standard drawing conventions | * Oral questioning * Written tests * Observation |
| 1. Produce solid geometry drawings | * Interpretation of sketches and drawings of patterns   + Cylinders   + Prisms   + Pyramids * Development of surface of interpenetrating solids and truncated solids * Interpenetrations of solids   + Cylinder to cylinder,   + Cylinder to prism,   + Prism to prism of equal and unequal diameters | * Observation * Written tests * Oral questioning |
| 1. Produce 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 * Free hand sketching of tools, equipment, components, geometric forms and diagrams | * Observation * Written test * Oral test |
| 1. Produce assembly drawings | * Explosion of orthographic views * Explosion of pictorial views * Identification and listing of parts * Production of sectional views * Hatching of drawings | * Observation * Written test * Oral test |
| 1. Apply CAD software in drawing | * Meaning and types of CAD e.g. * Auto CAD * Archi CAD * Solid works * Inventor * Circuit maker * Electronic work bench * 2D and 3D drafting technique * Annotation of models | * Practical * Observation * Written tests |

**Suggested Methods of Delivery**

* Projects
* Demonstration
* Practice by the trainee
* Field trips
* Group discussions
* Direct instructions

**Recommended Resources**

* + Drawing room
  + Computer lab
  + Drawing equipment and materials
  + Computers
  + CAD package
  + Overhead projector

# ENGINEERING MATHEMATICS

**UNIT CODE: ENG/CU/ME/CC/02/6/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Apply engineering mathematics**

**Duration of Unit:** 150 hours

**Unit Description**

This unit describes the competencies required by a technician in order to apply algebra apply trigonometry and hyperbolic functions, apply complex numbers, apply coordinate geometry, carry out binomial expansion, apply calculus, solve ordinary differential equations, carry out mensuration, apply power series, apply statistics, apply numerical methods, apply vector theory and apply matrix.

**Summary of Learning Outcomes**

1. Apply Algebra
2. Apply Trigonometry and hyperbolic functions
3. Apply complex numbers
4. Apply Coordinate Geometry
5. Carry out Binomial Expansion
6. Apply Calculus
7. Solve Ordinary differential equations
8. Carry out Mensuration
9. Apply Power Series
10. Apply Statistics
11. Apply Numerical methods
12. Apply Vector theory
13. Apply Matrix

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
| 1. Apply  Algebra | * Base and Index * Law of indices * Indicial equations * Laws of logarithm * Logarithmic equations * Conversion of bases * Use of calculator * Reduction of equations * Solution of equations reduced to quadratic   form   * Solutions of simultaneous linear   equations in three unknowns   * Solutions of problems involving AP and GP | * Written tests * Oral questioning * Assignments * Supervised exercises |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
| 2. Apply Trigonometr y and hyperbolic functions | * Half -angle formula * Factor formula * Trigonometric functions * Parametric equations * Relative and absolute measures * Measures calculation * Definition of hyperbolic equations * Properties of hyperbolic functions * Evaluations of hyperbolic functions Hyperbolic identities * Osborne’s Rule * Ashx + bshx=C equation * One-to-one relationship in functions * Inverse functions for one-to-one relationship * Inverse functions for trigonometric functions * Graph of inverse functions * Inverse hyperbolic functions | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 3. Apply complex numbers | * Definition of complex numbers * Stating complex |  Assignments  Oral questioning |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
|  | numbers in numbers in terms of conjugate argument and   * Modulus * Representation of complex numbers on the Argand diagram * Arithmetic operation of complex numbers Application of De   Moivre’s theorem   * Application of complex numbers to engineering | * Supervised exercises * Written tests |
| 4. Apply Coordinate  Geometry | * Polar equations * Cartesian equation * Graphs of polar equations * Normal and tangents * Definition of a point * Locus of a point in relation to a circle * Loci of points for given mechanism | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 5. Carry out Binomial  Expansion |  Binomial theorem Power series using binomial theorem Roots of numbers using binomial theorem. | * Written tests * Oral questioning * Assignments * Supervised exercises |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
|  |  Estimation of errors of small changes using binomial theorem. |  |
| 6. Apply Calculus | * Definition of derivatives of a function * Differentiation from fist principle * Tables of some common derivatives * Rules of differentiation * Rate of change and small change * Stationery points of functions of two variables * Definition of integration * Indefinite and definite integral * Methods of integration application of integration. * Integrals of hyperbolic and inverse functions | * Written tests * Oral questioning * Assignments * Supervised exercises |

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| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
| 7. Solve Ordinary differential equations | * Types of first order differential equations * Formation of first order differential equation * Solution of first order differential equations * Application of first order differential equations * Formation of second   order differential equations for various systems   * Solution of second order differential equations * Application of second order differential equations | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 8. Carry out  Mensuration | * Units of measurements * Perimeter and areas of regular figures * Volume of regular solids * Surface area of regular solids * Area of irregular figures * Areas and volumes using Pappus theorem | * Written tests * Oral questioning * Assignments * Supervised exercises |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
| 9. Apply Power Series | * Definition of the term power series * Taylor’s theorem * Deduction of   McLaurin’s theorem to obtain power series   * Application of Taylor’s theorem and McLaurin’s theorems in numerical work | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 10. Apply Statistics | * Measures of central tendency mean, mode and median * Measures of dispersion * Variance and standard deviation * Definition of probability * Laws of probability * Expectation variance and S.D. * Types of distributions * Mean, variance and SD of probability   distributions   * Application of probability distributions | * Assignments * Oral questioning * Supervised exercises * Written tests * Simulation * Data modelling |
| 11. Apply  Numerical |  Definition of interpolation and extrapolation | * Assignments * Oral questioning * Supervised |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
| methods | * Application of interpolation * Application of interactive methods to solve equations * Application of interactive methods to areas and volumes | exercises   Written tests |
| 12. Apply Vector theory | * Vectors and scalar in two and three dimensions * Operations on vectors:   Addition and  Subtraction   * Position vectors * Resolution of vectors | * Assignments * Oral questioning * Supervised exercises * Written tests |
| 13. Apply Matrix methods | * Matrix operation * Determinant of 3x3 matrix * Inverse of 3x3 matrix * Solution of linear simultaneous equations in 3 unknown * Application of matrices | * Assignments * Oral questioning * Supervised exercises * Written tests |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

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

# MECHANICAL SCIENCE PRINCIPLES

**UNIT CODE: ENG/CU/ME/CC/3/06/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Apply Mechanical science principles**

**Duration of Unit: 75** hours

**Unit Description**

This unit describes the competencies required by a technician in order to apply a wide range of Mechanical science principles in their work. It includes using concepts of mechanical science, determining effects of loading on static and dynamic engineering systems, analyse properties of materials, determine parameters of a fluid system and use of basic systems in power transfer.

**Summary of Learning Outcomes**

1. Determine forces in a system
2. Demonstrate knowledge of moments
3. Understand friction principles
4. Understand motions in engineering
5. Describe work, energy and power
6. Perform machine calculations
7. Demonstrate gas principles
8. Apply heat knowledge
9. Apply density knowledge
10. Apply pressure principles

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 1. Determine  forces in a  system | * Define force * State and explain force theorems * Calculation of resultant of co-planar forces * Resolve the forces * Calculate the resultant force and equilibrium * Discuss the application of different forces | * Written tests * Oral   questioning   * Assignments * Supervised exercises |
| 2. Demonstrate knowledge of moments systems | * Define moments * Explain the principle of moments * Calculation of couples * Calculation of moments of   a force, | * Written tests * Oral   questioning   * Assignments * Supervised exercises |
| 3. Understand friction  principles | * Definition of mechanical properties of materials * Draw the stress strain graph * Discuss application of material depending on their properties * Discuss effect of environmental factors on material properties. | * Assignments * Oral   questioning   * Supervised exercises * Written tests |

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| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 4. Understand motions in engineering | * Discussion of Pascal’s principles * Measuring fluid parameters * State the laws of gases * Discuss properties of water and steam | * Assignments * Oral   questioning   * Practical tests * Observation * Supervised exercises * Written tests |
| 5. Describe work, energy and power | * Uses and working principle of Gear trains * Uses and working principles of Pulley system,   hoists and lifts   * Uses and working principles of screws | * Assignments * Supervised exercises * Written tests * Practical test |
| 6. Perform machine calculations | * Definition of machine * Principle of machine calculation * Fundamentals of a machine * Dimensional units | * Assignments * Supervised exercises * Written tests |
| 7. Demonstrate gas principles | * Gas flow equations between parallel surfaces * Gas equations in circular pipes * Application of gas equations | * Assignments * Supervised exercises * Written tests * Practical test |
| 8. Apply heat knowledge | * Meaning of heat * Heat calculations | * Assignments * Supervised |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  |  | exercises   * Written tests * Practical test |
| 9. Apply density knowledge | * Assignments * Supervised exercises * Written tests * Practical test | * Assignments * Supervised exercises * Written tests    |
| 10. Apply pressure principles | * Meaning of pressure * Pressure calculations * Application of pressure principles | * Assignments * Supervised exercises * Written tests |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

# FLUID MECHANICS PRINCIPLES

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Apply fluid mechanics principles**

**Duration of Unit: 75** hours

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of fluid mechanics principles in their work. It includes understanding flow of fluids, demonstrating knowledge in viscous flow, performing dimensional analysis and operating fluid pumps

**Summary of Learning Outcomes**

1. Understand flow of fluids
2. Demonstrate knowledge in viscous flow
3. Perform dimensional analysis
4. Operate fluid pumps

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Learning Outcome** |  | **Content** | **Suggested**  **Assessment Methods** |
| 1. Understand flow of fluids |        | Flow rate in pipes is Losses in pipes are determined  Causes of losses in pipes  Flow losses equations | * Written tests * Oral   questioning   * Assignments * Supervised exercises |
| 2. Demonstrate knowledge in viscous flow |        | Viscous flow between parallel surfaces Viscous flow equations between parallel surfaces Viscous flow equations in circular pipes  Application of viscous flow equations | * Written tests * Oral   questioning   * Assignments * Supervised exercises |
| 3. Perform dimensional analysis |            | Dimensional analysis definition  Principle of dimensional homogeneity  Fundamental dimensions  Dimensional units  Physical quantities Application of dimensional analysis | * Assignments * Oral   questioning   * Supervised exercises * Written tests |
| 4. Operate fluid pumps |    | Principle of operation of pumps  Deriving Reciprocating | * Assignments * Oral   questioning |
| **Learning Outcome** |  | **Content** | **Suggested**  **Assessment Methods** |
|  |    | pump equation Deriving Centrifugal pump equation Application of Pump equation in problem solving | * Practical tests * Observation * Supervised exercises * Written tests |

**Suggested Delivery Methods**

* + 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
  + Dice
  + Computers with internet connection

# THERMODYNAMICS PRINCIPLES

**UNIT CODE: ENG/CU/ME/CC/5/06/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Apply thermodynamics principles**

**Duration of Unit: 75** hours

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply thermodynamics principles in their work. It includes understanding fundamentals of thermodynamics, performing steady flow processes, performing non steady flow processes, understanding perfect gases, generating steam, performing thermodynamics reversibility and entropy, understanding idea gas cycle, demonstrating fuel and combustion, perform heat transfer, understanding heat exchangers, understanding air compressors, understanding gas turbines and understanding of impulse steam turbines

**Summary of Learning Outcomes**

1. Understand fundamentals of thermodynamics
2. Perform steady flow processes
3. Perform non steady flow processes
4. Understand perfect gases
5. Generate steam
6. Perform thermodynamics reversibility and entropy
7. Understand idea gas cycle
8. Demonstrate fuel and combustion
9. Perform heat transfer
10. Understand heat exchangers
11. Understand air compressors
12. Understand gas turbines
13. Understanding impulse steam turbines

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

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| --- | --- | --- | --- | --- |
| **Learning Outcome** |  | **Content** |  | **Suggested**  **Assessment Methods** |
| 1. Understand fundamentals of  thermodynami  cs |      | Terms used in thermodynamics Thermodynamics processes and cycles First law of thermodynamics |        | Written tests Oral questioning Assignments Supervised exercises |
| 2. Perform steady flow processes |      | Deriving Steady flow energy equation Applying Steady flow energy equation  Application of Steady flow energy equation in utilities |        | Written tests Oral questioning Assignments Supervised exercises |
| 3. Perform non steady flow processes |    | Deriving non-flow energy equation  Application of Non-flow energy equation in problem solving |      | Assignments Oral questioning Supervised exercises |
|  |  |  |  | Written tests |
| 4. Understand perfect gases |    | State Perfect gas laws Carrying out Gas laws |    | Assignments Oral |

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| **Learning Outcome** |  | **Content** |  | **Suggested**  **Assessment Methods** |
|  |  | experiment  Application of Gas laws |  | questioning Supervised exercises |
|  |  |  |  | Written tests |
| 5. Generate steam |        | Determining Dryness  fraction  Determining Relationship between pressure and boiling point Carrying out Energy balance  Determining Relationship between temperature and pressure |          | Assignments Oral questioning Practical tests  Observation Supervised  exercises |
| 6. Perform thermodynami  cs reversibility and entropy |        | Thermodynamics  reversibility principles  Principles of heat engine  Second law of thermodynamics Entropy in thermodynamics |        | Assignments Oral questioning Observation Supervised exercises |
| 7. Understand idea gas cycle |      | Ideal gas cycle processes Air standard efficiency and actual efficiency are differentiated  Problems are solved in ideal gas cycle |    | Assignments Oral questioning |

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| --- | --- | --- | --- | --- |
| **Learning Outcome** |  | **Content** |  | **Suggested**  **Assessment Methods** |
| 8. Demonstrate fuel and combustion |        | Classification of fuels  Properties of fuels  Deriving of Combustion equation  Application of Combustion equation |        | Oral questioning Practical tests  Observation Supervised exercises |
| 9. Perform heat transfer |    | Deriving Conduction equation from Fourier’s law  Heat transfer equation is derived and applied from  Newton’s law of cooling and Fourier’s law |    | Assignments Oral questioning |
| 10. Understand heat exchangers |      | Classification of Heat exchangers Recuperative heat exchangers are described Application of Heat equations |          | Assignments Oral questioning Practical tests  Observation Supervised exercises |
| 11. Understand air compressors |      | Classification of Air compressors  Types of air compressors  Deriving and applying Equations of reciprocating compressors |          | Assignments Oral questioning Practical tests  Observation Supervised exercises |
| **Learning Outcome** |  | **Content** |  | **Suggested**  **Assessment Methods** |
| 12. Understand gas turbines |        | Theoretical cycle for gas turbines  Open cycle gas turbine  Closed cycle gas turbine Deriving Gas turbine equations |          | Assignments Oral questioning Practical tests  Observation Supervised exercises |
| 13. Understanding impulse steam turbines |    | Principles of operations of the impulse steam turbines  Deriving and applying Impulse steam turbine equation |        | Assignments Oral questioning Practical tests  Observation |
|  |  |  |  | Supervised exercises |

**Suggested Delivery Methods**

* 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
* Dice
* Computers with internet connection

# MATERIAL SCIENCE AND PERFORM METALLURGICAL PROCESSES

**UNIT CODE: ENG/CU/ME/CC/6/06/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Apply material science and perform metallurgical processes**

**Duration of Unit: 75** hours

**Unit Description:** The learner will be introduced to performing material testing and metallurgical processes. It involves analyzing properties of engineering materials, performing extraction processes, producing iron materials, ceramics, composites and alloys, performing heat treatment, material testing and identifying corrosion and its prevention

**Summary of Learning Outcomes**

1. Analyse properties of engineering materials
2. Perform ore extraction processes
3. Produce iron materials
4. Produce alloy materials
5. Produce non-ferrous materials
6. Produce ceramics materials
7. Produce composite materials
8. Utilise other engineering materials
9. Perform heat treatment
10. Perform material testing
11. Prevent material corrosion

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

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| --- | --- | --- | --- | --- |
| **Learning Outcome** |  | **Content** |  | **Suggested**  **Assessment Methods** |
| 1. Analyse properties of engineering materials |        | Engineering materials is identified as per the procedures  Physical properties of engineering material Mechanical properties of engineering materials Crystal structure of materials |        | Written tests Oral questioning Assignments Supervised exercises |
| 2. Perform ore extraction processes |          | Safety measures in metal extraction  Method of metal extraction  Procedure in metal extraction processes Storing of metal Extraction by- products  Disposing extraction by- products |        | Written tests Oral questioning Assignments Supervised exercises |
| 3. Produce iron materials |        | Ore smelting processes.  Composition of iron Method of producing iron material  Refinement processes |      | Assignments Oral questioning Supervised exercises |
|  |  |  |  | Written tests |
| 4. Produce alloy materials |    | Tools and equipment for alloy production  Alloy formation process |    | Assignments Oral questioning |

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| **Learning Outcome** |  | **Content** |  | **Suggested**  **Assessment Methods** |
|  |  | Testing alloy products quality |    | Practical tests Observation |
|  |  |  |  | Supervised exercises |
|  |  |  |  | Written tests |
| 5. Produce nonferrous materials |            | Extraction of Non-ferrous materials  Smelting and purifying of extracted non-ferrous material  Testing Non-ferrous material  Identifying Alloying elements for non-ferrous materials  Alloy formation process Testing of Alloys for nonferrous material |        | Assignments Supervised exercises Written tests  Practical test |
| 6. Produce ceramics materials |        | Composition of ceramic materials  Manufacturing process for ceramics  Production of Ceramic materials  Finishing processes for ceramic materials |        | Assignments Supervised exercises Written tests  Practical test |
| 7. Produce composite |    | Types of composites Elements involve in composite formation |    | Assignments Supervised exercises |

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| **Learning Outcome** |  | **Content** |  | **Suggested**  **Assessment Methods** |
| materials |    | Formation process of composites  Testing of composite materials |    | Written tests  Practical test |
| 8. Utilise other engineering materials |          | Identifying and selecting engineering materials  Developing operation plan Setting up production machine  Setting production parameters  Production process for engineering materials |        | Assignments Supervised exercises Written tests  Practical test |
| 9. Perform heat treatment |        | Safety practices procedures Heat treatment processes Procedure in heat treatment  processes  Operations of heat treatment of metals |        | Assignments Supervised exercises Written tests  Practical test |
| 10. Perform material testing |        | **Material testing methods** Procedure of material  testing  Analysing Material testing results  Material testing equipment are taken care of and maintained. |        | Assignments Supervised exercises Written tests  Practical test |
| **Learning Outcome** |  | **Content** |  | **Suggested**  **Assessment Methods** |
| 11. Corrosion and its prevention |          | Safety observation during corrosion prevention  Corrosion type is identified  Causes of corrosion Methods of corrosion prevention  Corrosion prevention |        | 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

* 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

# CORE UNITS OF LEARNING

# PRODUCING PARTS BY BENCH WORK

**UNIT CODE: ENG/CU/ME/CR/1/06/A**

**Relationship to Occupational Standards**: This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Produce parts by bench work**

**Duration of Unit:** 150 Hours

**Unit description**

The learner will be able to use different methods to produce work pieces 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 interpret and work within given specifications, select techniques and make variations to achieve specified results as well as perform housekeeping.

**Summary of Learning Outcomes**

1. Use personal protective equipment
2. Organize work area
3. Use a technical drawing to plan work operations
4. Measure and mark out dimensions on workpieces
5. Set up work pieces on holding devices
6. Use hand tools to cut and file parts
7. Use a hand drill to drill holes
8. Thread using taps and dies
9. Assemble metal parts and sub-assemblies
10. Polish finished work
11. Inspect finished work for accuracy and quality
12. Maintenance of tools and equipment

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

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 1. Use personal protective  equipment | * General safety * Use of PPE’s(Overall, gloves, eye shield, head cap, safety shoes, ear   masks)   * Machine safety * Occupational safety and health act, 2007 * WIBA act | * Administration of written and oral tests * Assessment of worksheet/ operation plans |
| 2. Organize work area | * Types of hand tools * Arrangement and storage of measuring tools, working tools, materials   and equipment   * housekeeping * segregation and disposal of waste | * Observation of   correct s   * Observation of arrangement and storage of workplace tools, materials * Observation of good housekeeping at the workplace * Administration of oral and written questions |
| 3. Using a technical drawing to plan work | * Read and interpret technical drawings * Produce a technical plan as per the technical drawing |  Observation of reading and interpretation of technical |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| operations |  | drawings   * Assessment of   operation plans   * Administration of oral and written questions |
| 4. Measure and mark out dimensions on workpieces | * Identify types and uses of measuring and 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 |
| 5. Set up work pieces on holding devices | * Types and application of work holding devices * Determination of the type of the work piece material * Selection of work holding device * Securing work piece(s) (clamping, jigs and fixtures, nuts and bolts) | * Observation of selection of work piece material * Observation of selection of work holding device * Administration of oral and written questions * Observation of securing work piece(s) |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 6. Use hand  tools to cut and file parts | * Types of hand tools * Uses of hand tools * Selection of tools as per the specific operation * Inspection and/or recalibration of tools * Demonstration of correct handling of tools | * Observation of correct selection of tools for specific operation * Observation of inspection and/or recalibration of tools * Observation of appropriate handling of tools * Administration of oral and written questions |
| 7. Use a hand  drill to drill holes | * Marking and centre punching the hole * Selecting and mounting   drill bits   * Mounting and clamping workpieces * Drilling hole to specification * Inspecting the hole | * Observation of   the drilling procedure and process   * Assessment of the   drilled hole   * Assessment of   functionality |
| 8. Threading using taps and dies | * Selecting taps and dies based on operation plan * Setting up the taps and dies * Cutting threads to specifications | * Observation of   selection of taps and dies   * Observation of setting up taps and dies |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  |  |  Observation of thread cutting by taps and dies |
| 9. Assemble  metal parts and subassemblies | * fitting parts * Quality control   (Dimensions, Tolerances,  surface finishing,  Alignment) | * Observation of the joined or fitted parts * Assessment of the   joined or fitted parts   * Assessment of functionality |
| 10. Polish finished work | * Polishing * Cleaning |  Assessing polishing and cleaning of parts |
| 11. Inspect finished work for accuracy and quality | * Measuring * Surface finishing * Functionality |  Assessing measurements, finishing and functionality of machined parts |
| 12. Maintenance of tools and equipment | * Cleaning tools and equipment after operations * Servicing and maintenance of tools and equipment (lubrication, inspection, alignment and adjustment, coolant, safety guard) | * Observation of cleaning of lathe machine tool * Observation of servicing and maintenance of tools and equipment administration of oral and written |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  |  | tests. |

**Suggested Delivery Methods**

* Demonstration by trainer
* Discussions
* Practical work by trainee(s)
* Exercises
* Industrials visits
* YouTube for teaching/learning and inspiration.
* Simulation

**List of Recommended Resources**

Tools and equipment suggested but not limited to:

* Welding
* Drilling machines
* Vices
* Burnishing machine
* Cutting tools
* Combination square
* Centre punch
* Centre drill
* Countersunk drill
* Marking out tools
* 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
* Vacuum cleaners
* Mops/ Brooms and buckets
* 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
* Zink sheets
* Aluminum sheets
* Bright Drawn Mild Steel
* Carbon steel
* Brass rods
* Aluminum rods
* Abrasive materials
* Grinding paste
* Cotton wastes
* Cleaning detergents

# SHEET METAL WORK

**UNIT CODE: ENG/CU/ME/CR/2/06/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Sheet Metal Work**

**Duration of Unit:** 140 hours

**Unit Description**

This unit describes occupational standards for sheet metal work. The technician will be able to use different techniques to fabricate parts using sheet metal while observing rules and procedures. In the context of the standards, the technician is to interpret and work within given specifications, select techniques and make variations to achieve specified results as well as perform housekeeping.

**Summary of Learning Outcomes**

1. Observing safety and regulations
2. Identifying parts of sheet metal machine tool
3. Using sheet metal tools
4. Reading and interpreting working drawing
5. Marking out of work piece
6. Setting up of sheet metal machine tool for a specific operation
7. Producing fabricated component(s) according to specifications
8. Assessing quality of fabricated component(s)
9. Maintenance of sheet metal machine
10. Performing housekeeping

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

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| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Observing safety and regulations | * General safety * Use of PPE’s (Overall, eye shield, safety   shoes, gloves)   * Machine safety * Occupational   safety and health act, 2007   * OSH ACT 2007 * Workshop rules and regulations * Safe working environment (workshop layout, waste sorting and disposal) | * Observation of use of   PPEs   * Observation of safe working procedures and operations * Administration of oral and written tests * Administration of simulated tests |
| 2. Identifying sheet metal machines | * Types of machine   tools use in sheet metalwork(guilloti ne machine, bending machine, rolling machine)   * Parts of machine tools used in sheet metalwork * Functions of the parts of machine | * Administration of written and oral test * Administration of simulated tests |

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| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
|  | tools used in sheet metalwork   Operating machine |  |
| 3. Using sheet metal tools | * Types and uses of sheet metal tools and machines * Parts of sheet metal machines * Selection of sheet metal tools | * Administration of written and oral test * Administration of simulated tests * Observation of   selection of tools |
| 4. Reading and  interpreting working drawing | * Reading and extraction of information (dimensions, tolerances, BS/ANSI Drawing Standards, geometric ISO symbols &   abbreviations)   * Development   of operational plan | * Administration of written and oral test * Assessment of worksheet/ operation plans |
| 5. Marking out of work pieces | * Laying out work piece(s) * Marking out dimensions | * Observation of laying out of work piece(s) * Assessment of transferred dimensions |
| 6. Setting up of sheet |  Identifying sheet metal operation |  Administration of simulated tests |

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| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| metal machine | * Setting sheet metal machine * Securing work   piece |  Observation of setting machine tool and securing work piece |
| 7. Producing fabricated component (s) according to specifications | * Cutting * Folding * Forming * Rolling * Drilling * Punching * Edge treatment * Joining * Soldering * brazing * riveting, * bolting * screwing * seaming * welding * bending | * Observation of fabricated component(s) * Administration of oral and written tests/assignments * Administration of simulated tests |
| 8. Assessing functionality of fabricated  component(s) | * Measuring * inspection * surface finishing * Functionality | * Assessing measurements, finishing and functionality of machined parts * Administration of simulated tests |
| 9. Maintenance of sheet metal |  Cleaning sheet metal machine |  Observation of cleaning of sheet |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| machines | tool after operations   Servicing and maintenance of sheet metal machine  (lubrication, inspection, alignment and adjustment) | metal machine tool   * Observation of servicing and maintenance of the sheet metal machine tool * Administration of   oral and written tests |
| 10. Performing housekeeping | * Cleaning of work environment (waste sorting and   disposal)   * Cleaning and   storing of tools and equipment   * Servicing and maintenance of machine   (lubrication, inspection, alignment and | * Observation of cleaned working environment * Observation of cleaned and stored sheet metal tools and equipment |

**Suggested Delivery Methods**

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

**List of Recommended Resources**

Tools & Equipment

* Measuring tools
* Marking out tools
* Assorted hand tools
* Inspection tools and equipment
* Work benches
* Assorted work holding devices
* Guillotine
* Arc welding equipment
* Gas welding equipment
* Bender
* Roller
* Shear
* Snips
* Formers
* Drill and drill bits
* Firefighting equipment
* Templates

Materials and supplies

* PPEs – dust coat, safety boots, goggles
* Raw materials
* Mild steel sheet  Brass sheet
* Aluminum sheet, etc.  First Aid kit
* Brooms and cleaning stuff
* Cotton waste
* Cleaning detergents
* Drawing papers
* Working drawings
* Operation sheets/ templates
* Brazing flux
* Soldering rod
* Welding rods
* Brazing rods

# JOINING PARTS BY MANUAL METAL ARC WELDING

**UNIT CODE: ENG/CU/ME/CR/3/06/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards**:** **Join parts by Manual Metal Arc Welding**

**Duration of Unit:** 140 Hours

**Unit Description**

This unit describes occupational standards for manual metal Arc welding. The technician will be able to use different techniques in arc welding while observing rules and procedures. In the context of the standards, the technician is to interpret and work within given specifications, select techniques and make variations to achieve specified results as well as perform housekeeping.

**Summary of Learning Outcomes**

1. Observing safety and regulations
2. Identifying parts of arc welding machine
3. Identifying welding joints and welding positions
4. Using of electrodes
5. Reading and interpreting working drawing
6. Preparing work piece
7. Setting up of arc welding machine
8. Producing manual metal arc welded component(s) according to specifications
9. Assessing quality of welded component(s)
10. Maintenance welding machine
11. Performing housekeeping

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

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 1. Observing safety and  regulations | * General safety * First Aid * Use of PPE’s (Overall, welding Goggles, Safety boots, Welding Gloves,   Face shield,  Welding Overall/apron,  Head cap,  Dust mask)   * Machine safety (worn out/ loose cables and handles, fault connection, fuse blown, coiled cables wires, Overloading, etc.) * Occupational safety and health act, 2007 * OSH Act 2007 * WIBA Act 2007 * National Environment Management Authority   Act, Kenya 2004 | * Observation of use of PPEs * Observation of safe working procedures and operations * Administration of oral and   written tests   * Administration of simulated tests |
| 2. Identifying parts of arc welding  machine | * Definition of manual arc welding * Types of manual arc welding machines * Parts and functions of a manual arc welding | * Administration of written and   oral test   * Administration of simulated tests |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  | machine |  |
| 3. Identifying weld joints and welding  positions | * Types of welding joints * Welding joint symbols * Joint preparation * Profile of a weld * Welding defects * Types of welding position * Flat * Overhead * Vertical * Horizontal | * Administration of written and   oral test   * Administration of simulated tests |
| 4. Using electrodes | * Types of electrodes * Types of electrode coating * Selection of electrodes * Classification of electrodes * Care and storage of electrodes | * Administration of written and oral   test/assignments   * Administration of simulated tests |
| 5. Reading and interpreting working drawing | * Reading and extraction of information (dimensions, tolerances, BS/ANSI Drawing Standards, geometric ISO symbols & abbreviations) * Development of operational plan | * Administration of written and   oral test   * Assessment of worksheet/ operation plans |
| 6. Preparing work piece | * Laying out work piece(s) * Marking of dimensions |  Observation of laying out of |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  | onto the work piece(s)   * Preparing of edges * Cutting * Cleaning/Deburring * Joint geometry (For both plate and pipe) * 1F * 2F * 3F * 4F * 1G * 2G * 3G * 4G * 5G * 6G | work piece(s), prepared edges and joint geometry   * Assessment of transferred dimensions * Administration of oral and written tests |
| 7. Setting up of arc welding machine | * AC/DC Setting * Polarity and cable connection * straight polarity * reverse polarity * Setting parameters * Amperage * Voltage | * Administration   of oral and  written tests   * Observation of connection cables/leads, set up parameters |
| 8. Producing arc welded component(s  ) | * Tack weld * Adjust root gap * Arc weld * Cleaning welded surfaces | * Administration   of oral and  written tests   * Observation of |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  |  | tack weld, root gap adjustment, welding process, and after weld  cleaning   Administration of simulated  tests |
| 9. Assessing weld quality | * Measuring * Surface finishing * Functionality * Weld defects * Weld tests * Non-destructive testing and inspection * Destructive testing and inspection | * Assessing measurements, finishing and functionality of weld parts * Administration of simulated tests * Assessment of weld parts |
| 10. Caring and maintenance of welding machine | * Disconnecting welding machine after operations * Servicing of welding machine * Cleaning of welding machine * Calibration of welding machine | * Observation of cleaning of welding machine * Observation of servicing and maintenance of the welding machine * Administration of oral and |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  |  | written tests |
| 11. Performing housekeeping | * Cleaning of work environment (waste sorting and disposal) * Cleaning and storing of tools and equipment * Cleaning of welding bay | * Observation of clean working environment * Observation of clean and stored tools and equipment, and welding bay |

**Suggested Delivery Methods**

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

**List of Recommended Resources**

**Recommended Resources**

Tools & Equipment

* Measuring tools
* Marking out tools
* Arc welding machine
* Marking out tools
* Chipping hammer
* Inspection tools and equipment
* Angle grinder
* Work benches
* Bench vices
* Wire brush
* File card
* Firefighting equipment
* Electrode cabinet/oven
* Jigs and fixtures Materials and supplies
* PPEs – dust coat, leather, face shield, spats, gloves, safety boots, goggles  Raw materials
* GI pipes
* Mild steel plates & sheets
* First Aid kit
* Brooms and cleaning stuff
* Cotton waste
* Cleaning detergents
* Drawing papers
* Working drawings
* Operation sheets/ templates
* Electrodes

# LATHE WORK

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Produce Lathe work**

**Duration of Unit:** 120 hours

**Unit Description**

The learner will be able to prepare a machine tool and do machining to achieve material removal whilst adhere to rules and procedures. In the context of this standard, the learner is to interpret and work within given specifications, selecting techniques and making variations to achieve specified result as well as perform housekeeping.

**Summary of Learning Outcomes**

1. Observing safety
2. Identifying machine parts and their functions
3. Using of cutting tools (types of tools, selection, material of varied tools, sharpening)
4. Using of cutting fluids
5. Identifying machine operations
6. Reading and interpreting working drawing
7. Marking out of work piece
8. Setting up machine tool for specific job
9. Producing machined parts according to specifications
10. Assessing quality of machined parts
11. Maintenance of machine tool
12. Performing housekeeping

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

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| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| **1.** Observing safety | * General safety * Use of PPE’s (Overall, eye shield, safety shoes) * Machine safety * Occupational safety and health act, 2007 * OSH act 2007 * Workshop rules and regulations * Safe working environment (workshop layout, waste sorting and disposal) | * Observation of use of PPEs * Observation of safe working procedures and operations * Administration of oral and written tests |
| 2. Identifying machine parts and their functions | * Definition of a lathe * Types of lathe * Parts of a lathe * Functions of the parts of a lathe |  Administration of written and oral  test |
| **3.** Using of cutting tools | * Types of materials for making cutting tools * Types and geometry of   cutting tools   * Selection of cutting tools * Sharpening of cutting tools |  Administration of written and oral  test/assignments |
| 4. Using of |  Types of cutting fluids |  Administration of |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| cutting fluids | * Composition of cutting   fluids   * Selection of cutting fluids * Advantages/disadvantage   s of cutting fluids   * Handling cutting fluids | written and oral  test |
| 5. Identifying machine operations | * Facing * Surface turning * Step turning * Thread cutting * Taper turning * Knurling * Boring * Drilling * Chamfering * Parting-off * Countersinking * Counter-boring |  Administration of written and oral  test |
| 6. Reading and interpreting working drawing | * Reading and extraction of information (dimensions, tolerances, BS/ANSI Drawing Standards, geometric ISO symbols &   abbreviations)   * Development of operational plan | * Administration of written and oral test * Assessment of worksheet/ operation plans |
| 7. Marking out of |  Laying out work piece(s) |  Observation of |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| work piece |  Marking out dimensions | laying out of work piece(s)   Assessment of transferred dimensions |
| 8. Setting up machine tools for specific jobs | * Identifying the operation * Selecting and mounting   cutting tool   * Securing work piece * Calculate speed and feed   rate   * Selecting cutting speed and feed rate | * Administration of oral and   written tests   * Observation of selection and mounting of cutting tools, securing work piece and selecting cutting speeds and feed rates |
| 9. Producing machined parts according to specifications | * Turning * Threading * Countersinking * Counter-boring * Knurling * Drilling * Boring | * Observation of performed machining operations * Administration of oral and written tests |
| 10. Assessing finish of  machined | * Measuring * Surface finishing * Functionality |  Assessing measurements, finishing and |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| parts |  | functionality of machined parts |
| 11. Maintenance of lathe | * Cleaning lathe tool after operations * Servicing and maintenance of lathe (lubrication, inspection, alignment and adjustment, coolant, safety guard) | * Observation of cleaning of lathe machine tool * Observation of servicing and maintenance of the machine * Administration of oral and written tests |
| 12. Performing housekeeping | * Cleaning of work environment (waste sorting and disposal) * Cleaning and storing of tools and equipment * Servicing and maintenance of machine (lubrication, inspection,   alignment and adjustment) | * Observation of clean working environment * Observation clean and stored tools and equipment |

**Suggested Delivery Methods**

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

**List of Recommended Resources**

Tools & Equipment

* Measuring tools
* Marking out tools
* Hand tools
* Inspection tools and equipment
* Work benches
* Surface plate
* V-blocks
* Assorted work holding devices
* Lathe machine
* Firefighting equipment
* Assorted gauges
* Assorted cutting tools

Materials and supplies

* PPEs – dust coat, safety boots, goggles
* Raw materials
* Mild steel bar
* Brass bar
* Aluminum round bar, etc.  First Aid kit
* Brooms and cleaning stuff
* Cotton waste
* Cleaning detergents
* Drawing papers
* Working drawings
* Operation sheets/ templates

# MILLING WORK

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Milling work**

**Duration of Unit:** 140 hours

**Unit Description**

The learner will be introduced to machining and cut technology and achieve material removal as per the specifications, whilst adhere to safety and health regulations. In the context of this standard, the learner is to interpret and work within given specifications, selecting techniques and making variations to achieve specified results as well as perform housekeeping.

**Summary of Learning Outcomes**

1. Observing safety and regulations
2. Identifying machine parts and their functions
3. Using milling cutters
4. Using cutting fluids
5. Identifying milling operations
6. Reading and interpreting working drawing
7. Marking out of work piece
8. Setting up milling machine tool for a specific operation
9. Producing milled parts according to specifications
10. Assessing quality of machined parts
11. Maintenance of milling machine tool
12. Performing housekeeping

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

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| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
| 1. Observing safety and  regulations | * General safety * Use of PPE’s (Overall, eye shield, safety shoes) * Machine safety * Occupational safety and health act, 2007 * OSH Act 2007 * WIBA Act 2007 | * Observation of use of PPEs * Observation of safe working procedures and operations * Administration of oral and written tests * Administration of simulated tests |
| 2. Identifying milling machine parts and their  functions | * Milling machine tool * Types of milling machine * Parts of a milling machine * Functions of the parts of a milling machine | * Administration of written and oral test * Administration of simulated tests |
| 3. Using milling cutters | * Milling cutter materials * Geometry of milling   cutters   * Selection of milling cutters * Mounting of milling   cutters   * Sharpening of milling cutters | * Administration of written and oral test/assignments * Administration of simulated tests |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
| 4. Using cutting  fluids | * Types of cutting fluids * Composition of cutting   fluids   * Selection of cutting fluids * Uses of cutting fluids * Advantages/disadvantage   s of cutting fluids   * Handling of cutting fluids | * Administration of written and oral tests * Administration of simulated tests |
| 5. Identifying milling operations | * Face milling * Slot milling * Keyway milling * End milling * Side milling * Form milling * Angular milling * Gang milling * Indexing * Direct * Simple/plain * differential | * Administration of written and oral test * Administration of simulated tests |
| 6. Reading and interpreting working drawing | * Reading and extraction of information (dimensions, tolerances, BS/ANSI Drawing Standards, geometric ISO symbols & abbreviations) * Development of operational plan | * Administration of written and oral test * Assessment of worksheet/ operation plans |
| 7. Marking out |  Laying out work piece(s) |  Observation of |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
| of work piece |  Marking out dimensions in work piece | laying out of work  piece(s)   Assessment of transferred dimensions |
| 8. Setting up milling machine | * Identifying milling operation * Selecting and mounting milling cutters * Securing work piece * Calculating speed and feed rate * Selecting milling speed and feed rate | * Administration of oral and written   tests   * Observation of selection and mounting of milling cutters, securing of work piece and selecting milling speeds and feed rates |
| 9. Producing milled parts | * Face milling * Slot milling * Keyway milling * End milling * Side milling * Form milling * Angular milling * Gang milling * Indexing * Direct * Simple/plain * differential | * Observation of performed machining operations * Administration of oral and written tests/assignments * Administration of simulated tests |
| 10. Assessing |  Surface finish |  Assessing |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment Methods** |
| surface finish | * Functionality * Dimension and tolerance to specification | measurements,  finishing and functionality of machined parts   Administration of simulated tests |
| 11. Caring and maintenance of milling machine tool | * Cleaning milling machine tool after operations * Servicing and maintenance of milling machine (lubrication, inspection, alignment and adjustment) | * Observation of cleaning of milling machine tool * Observation of servicing and maintenance of the milling machine * Administration of oral and written tests |
| 12. Performing housekeeping | * Cleaning of work environment (waste sorting and disposal) * Cleaning and storing of tools and equipment | * Observation of clean working environment * Observation clean and stored tools and equipment |

**Delivery Methods**

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

**List of Recommended Resources Tools** & Equipment

* Measuring tools
* Marking out tools
* Hand tools
* Inspection tools and equipment
* Workbenches
* Assorted vices
* Assorted milling cutters
* Milling machine
* Indexing head
* Surface plate
* V-blocks
* Firefighting equipment
* Assorted gauges
* Jigs and fixtures Materials and supplies
* PPEs –hand gloves, dust coat, dust masks
* Raw materials
* Metal plates
* Metal bars
* Rods
* First Aid kit
* Brooms and cleaning stuff
* Cotton waste
* Cleaning detergents
* Drawing paper

# SURFACE GRINDING

**UNIT CODE: ENG/CU/ME/CR/6/06/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Produce parts by grinding machine tool**

**Duration of Unit:** 140 hours

**Unit Description**

The learner will be introduced to use of grinding technology involved in machining surfaces and methodology applied for setup and operation of the grinding machine tool. The unit also covers personal safety precaution, general safety, machine tool safety and work area safety.

**Summary of Learning Outcomes**

1. Observing safety and regulations
2. Identifying parts of a grinder and their functions
3. Using grinding wheels and stones
4. Using of coolant
5. Identifying grinding operations
6. Reading and interpreting working drawing
7. Setting up grinding machine tool for a specific operation
8. Producing ground parts according to specifications
9. Assessing quality of ground parts
10. Maintenance of grinding machine tool
11. Performing housekeeping

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

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 1. Observing safety and regulations | * General safety * Use of PPE’s (Overall, ear mask, dust mask, goggles, safety shoes) * Machine safety * Occupational safety and health Act, 2007 * OSH Act 2007 * WIBA Act 2007 | * Observation of use of PPEs * Observation of safe working procedures and operations * Administration of oral and   written tests   * Administration of simulated tests |
| 2. Identifying parts of a grinder and their functions | * Grinding machine * Types of grinders * Parts of a grinding machine * Functions of grinding machine | * Administration of written and   oral test   * Administration of simulated tests |
| 3. Using grinding wheels and stones | * Types of grinding wheels/stones * Classification grinding wheels * Grinding wheel defects * Grinding wheels calculation and geometry * Wheel dressing | * Administration of written and   oral test   * Administration of simulated   tests   * Observation of wheel dressing, |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  | * Wheel balancing * Wheel truing | balancing and truing |
| 4. Using of coolant | * Types of coolants * Composition of coolants * Selection of coolants * Uses of coolants * Advantages/disadvantage   s of coolants   * Handling of coolants | * Administration of written and   oral tests   * Administration of simulated tests * Observation of coolant selection, balancing and truing |
| 5. Identifying grinding operations | * Surface grinding * Internal grinding * Cylindrical grinding * Centreless grinding * Special grinding processes | * Administration of written and   oral tests   * Administration of simulated   tests |
| 6. Reading and interpreting working drawing | * Reading and extraction of information (dimensions, tolerances, BS/ANSI Drawing Standards, geometric ISO symbols &   abbreviations)   * Development of operational plan | * Administration of written and   oral test   * Assessment of worksheet/ operation plans |
| 7. Setting up |  Identifying grinding |  Administration |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| grinding machine | operation   * Selecting and mounting grinding wheels/stones * Securing work piece * Selecting grinding speed and feed rate | of oral and written tests   Observation of selection and mounting of grinding wheels, securing of work piece and selecting grinding speeds and feed rates |
| 8. Producing ground parts | * Surface grinding * Internal grinding * Cylindrical grinding * Centreless grinding * Special grinding processes | * Administration of oral and   written tests   * Observation of surface grinding, internal grinding, centerless grinding and special grinding   processes   * Administration of simulated tests |
| 9. Assessing quality of ground parts | * Measuring/dimensional accuracy * Surface finish |  Assessing measurements, finishing and |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  |  Functionality | functionality of ground parts   Administration of simulated  tests |
| 10. Maintenance of grinding  machine tool | * Cleaning grinding machine * Servicing and maintenance of grinding machine (lubrication, inspection, alignment and adjustment) | * Observation of cleaning of grinding machine tool * Observation of servicing and maintenance of the grinding machine tool * Administration of oral and written tests |
| 11. Performing housekeeping | * Cleaning of work environment (waste sorting and disposal) * Cleaning and storing of tools and equipment * Storing of grinding wheels/stones | * Observation of clean working environment * Observation of clean and stored tools and equipment, and storing of grinding wheels/stones |

**Suggested Delivery Methods**

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

**List of Recommended Resources**

**Recommended Resources** Tools and equipment

* Measuring tools and gauges
* Marking out tools
* Assorted hand tools
* Inspection tools and equipment
* Workbenches
* Bench vices
* Grinding wheels of various types and brand
* Balancing attachment
* Dressing tools
* Slat blocks and grinding vice
* Firefighting equipment
* Grinding machine tool

Materials and supplies

* PPEs –dust coat, dust masks, ear muffs, goggles
* Assorted grinding wheels/stones
* First Aid kit
* Brooms and cleaning stuff
* Cotton waste
* Cleaning detergents
* Drawing papers
* Coolant

# WORKSHOP PROCESSES

**UNIT CODE: ENG/CU/ME/CR/7/06/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **perform workshop processes**

**Duration of Unit: 100** hours

**UNIT DESCRIPTION**:

This unit specifies the competencies required to perform workshop processes. It involves performing mechanical bench works, carrying out metal joining processes, operating lathe machines, operating milling machines, operating grinding machine and operating drilling machine. It also involves performing sheet metal works and foundry works.

**Summary of Learning Outcomes**

1. Perform mechanical bench works
2. Perform forging operations
3. Carry out metal joining processes
4. Operate lathe machine
5. Operate milling machine
6. Operate grinding machine
7. Operate drilling machine
8. Perform sheet metal works
9. Perform non-traditional machining
10. Perform foundry works

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

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 1. Perform mechanical bench works | * Occupational health and safety in the mechanical workshop * Designing of mechanical workshop * Performing measuring and layout * Workshop hand tools * Hand drills * Operation of hand tools * Cutting internal and external threads * Maintaining and storing hand tools | * Practical * Observation * Administration of oral and   written tests   * Administration of simulated tests |
| 2. Perform forging operations | * Safety precautions on hot and cold working processes * Preparation of operation plan * Preparation of materials * Selection of cold and hot forming tools * Drawing down * Fullering * Punching * Upsetting * swaging | * Observation of use of PPEs * Observation of safe working procedures and operations * Administration of written and   oral test   * Administration of simulated   tests |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  | * Inspecting work piece * Care and maintenance of forging tools * Housekeeping processes * Preparation of job cards |  |
| 3. Carry out metal joining processes | * Safety operations * Materials, tools and equipment for metal joining * Welding process. * Metal riveting operations * Brazing operations * Soldering * Mechanical fastenings * Adhesive bonding * Quality control | * Observation of use of PPEs * Observation of safe working procedures and operations * Administration of written and   oral test   * Administration of simulated tests |
| 4. Operate lathe machine | * Safety precautions on lathe machine * Preparation of operation plan * Preparation of materials * Types of Lathe machines * Centre lathe * Capstan and turret lathe * CNC turning centre * Cutting tools and lathe | * Observation of use of PPEs * Observation of safe working procedures and operations * Administration of written and   oral test   * Administration of simulated |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  | accessories   * 3-jaw and 4-jaw chuck * Face plate * Mandrel * Drive plate and lathe dog * Travelling and fixed steady * Checking Machine condition * Mounting work piece on lathe machine * Mounting cutting tools * Calculating Machining parameters * Operating Lathe machine * Inspecting work piece * Housekeeping processes * Preparation of job cards | tests |
| 5. Operate milling machine | * Safety precautions on milling machine * Preparation of operation plan * Preparation of materials * Types of milling machines * Horizontal | * Administration of written and   oral tests   * Administration of simulated tests |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  | * Vertical * Universal * CNC vertical milling machine * Cutting tools and milling accessories * Checking Machine condition * Mounting work piece on milling machine * Mounting cutting tools * Calculating Machining parameters * Operating milling machine operations * Inspecting work piece * Housekeeping processes * Preparation of job cards |  |
| 6. Operate grinding machine | * Safety precautions on grinding machine * Preparation of operation plan * Preparation of materials * Types of grinding machines * Cutting tools and grinding accessories * Checking Machine | * Administration of written and   oral tests   * Administration of simulated   tests |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  | condition   * Mounting work piece on grinding machine * Mounting cutting tools * Calculating Machining parameters * Operating grinding machine operations * Inspecting work piece * Housekeeping processes * Preparation of job cards |  |
| 7. Operate drilling machine | * Safety precautions on drilling machine * Preparation of operation plan * Preparation of materials * Types of drilling machines * Cutting tools and drilling accessories * Checking Machine condition * Mounting work piece on drilling machine * Mounting drilling tools * Calculating Machining parameters * Operating drilling | * Administration of written and   oral test   * Assessment of worksheet/ operation plans |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  | machine operations   * Inspecting work piece * Housekeeping processes * Preparation of job cards |  |
| 8. Perform sheet metal works | * Safety precautions in metal works * Selecting sheet metal materials * Developing Pattern * Cutting Sheet metal * Bending/ rolling/ embossing/ piercing/ blanking/forming Sheet metal work * Fabricating Metal sheet * Inspecting Fabricated product | * Observation of use of PPEs * Observation of safe working procedures and operations * Administration of oral and written tests |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 9. Perform non-  traditional manufacturing | * Safety precautions on grinding machine * Preparation of operation plan * Preparation of materials * Types of non-traditional machining machines * Calculating Machining parameters * Operating non-traditional machining machines  Abrasive jet machine * Abrasive water jet machine * laser jet machine etc. | * Administration of written and   oral test   * Assessment of worksheet/ operation plans |
| 10. Perform foundry works | * Safe working procedures for foundry works * Producing Moulding patterns * Producing Moulds * Melting Metal materials in a furnace * Producing Castings * Cleaning and inspecting Castings | * Administration of oral and   written tests   * Administration of simulated tests |

**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

* Measuring tools and gauges
* Marking out tools
* Taps and dies
* Inspection tools and equipment
* Dressing tools
* Firefighting equipment
* Furnaces
* Welding machines
* CNC Lathe machines
* Grinding machines
* CNC Milling machines
* Drilling machines
* Press
* Hearth
* Swages
* Hammers
* Tongs
* Fullers
* Sheet metal cutters
* Abrasive jet machine
* Abrasive water jet machine
* laser jet machine

**Materials and supplies**

* PPEs –dust coat, dust masks, ear muffs, goggles
* First Aid kit
* Brooms and cleaning stuff
* Cleaning detergents
* Drawing papers
* Welding rods
* Oxygen gas
* Acetylene gas
* Inspecting materials
* Coolant
* Lubricants

# WORKSHOP PROCESSES

**UNIT CODE: ENG/CU/ME/CR/8/6/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Manage workshop processes.**

**Duration of Unit: 100** hours

**Unit Description:**

This unit specifies the competencies required to manage workshop processes. It involves setting up and operationalizing of mechanical workshop, managing floor operations, tools, equipment and facilities. Storage of tools/ equipment and disposal of used materials are also incorporated in this competency

**Summary of Learning Outcomes:**

1. Set up mechanical workshop
2. Operationalize mechanical workshop
3. Manage workshop floor operations
4. Procure and control stock
5. Oversee plant maintenance
6. Maintain workshop database
7. Control workshop finance
8. Manage workshop storage facility
9. Organise scrap/dead stock disposal

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

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 1.Set up mechanical  workshop | * Location of mechanical workshop * Workshop equipment and budgetary plans. * Workshop planning and layout * Workshop personnel and minimum requirements * Storage of workshop equipment and tools. | * Practical exercises * Oral questioning * Written test * Learner portfolio of evidence. |
| 2. Operationalize mechanical workshop | * Legalization and   certification of mechanical workshop with relevant authorities   * Management of mechanical workshop staffs. * Material requisition and procurement procedures. * Procurement procedures of workshop facilities. * Preparation of workshop operationalization documents (e.g. strategic plan, work plan) * Computerization of the | * Practical * Project * Observation * Written test |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  | workshop operations. |  |
| 3. Manage workshop floor  operations | * Occupational health and safety procedures in the workshop * Local and international safety standards in the workshop. * Workflow and   procedures in the workshop operations.   * Definition of job cards * Importance of job cards * Management and   approvals of job cards in the workshop.   * Material requisition in the workshop operations. * Insurance of workshop and personnel * Tests done in the vehicle workshop * Installations and maintenance of workshop machineries and equipment. * Daily workshop reports. | * Practical exercises * Oral questioning * Written test |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 4. Procure and control stock | * Database * Importance * Use * Types * Procurement procedures and approvals * Stock control * Definition * Techniques * Procurement terms and conditions * Procurement act. | * Practical exercises * Oral questioning * Learner portfolio of evidence. |
| 5. Oversee plant maintenance | * Preparing maintenance schedules * Identification of maintenance personnel * Tools and equipment   identification   * Procurement of spare   parts   * Maintenance supervision * Monitoring of machine performance | * Practical exercises * Oral questioning * Written test |
| 6. Maintain workshop database | * Classification of workshop equipment * Management in the workshop * Approvals of workshop | * Practical exercises * Oral questioning * Written test * Learner portfolio of evidence. |

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| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  | procedures   * Types of database * Computerization of workshop procedures. * Safety of workshop database |  |
| 7. Control workshop finance | * Sources of workshop finance * Budgetary plans for workshop procedures. * Workshop expenditure and finance authorization * Preparation of financial reports. | * Practical exercises * Oral questioning * Written test * Learner portfolio of evidence. |
| 8. Manage workshop  storage facility | * Importance of storage facilities in the workshop  Classification of storage facilities in the workshop * List of storage facilities * Management of the workshop * Special storage facilities. | * Practical * Oral * Written test |
| 9. Organise scrap/dead stock disposal | * Dead stock definition * Types of dead stock * Causes of dead stock * Control of dead stock * Disposal act * Classification of | * Practical * Oral * Written test * Project |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
|  | workshop stocks |  |

**Suggested Methods of Delivery**

* + Presentations and practical demonstrations by trainer;
  + Guided learner activities and research to develop underpinning knowledge;
  + Supervised activities and projects in a workshop;

The delivery may also be supplemented and enhanced by the following, if the opportunity allows:

* + Visiting lecturer/trainer from the motor vehicle service and repair sector;
  + Industrial visits.

**Recommended Resources**

**Tools**

Comprehensive set of hand and power tools for the diagnosis service and repair of vehicle electrical systems

**Equipment**

* + Computer
  + Storage cabinets
  + Files
  + A fully equipped mechanical workshop;
  + Specialist tools and diagnostic equipment appropriate for the

different makes and types of mechanical systems that are being maintained including multi-meters, scanners and code readers;

* + Internet access to manufacturers’ technical information
  + Personal protective equipment (PPE);
  + Facilities for the disposal of used parts;
  + Customer database and systems for recording maintenance records.  Workshop materials database

**Materials and supplies**

Digital instructional material including DVDs and CDs

Consumables for service and repair of vehicle electrical systems including:

* + Cutting oils
  + Seals, fasteners and fittings
  + Cleaning materials
  + Dusters

**Reference materials**

* + Manufacturers service manuals for the machines that are being serviced;
  + Appropriate automotive engineering text books available on numerous websites