

**REPUBLIC OF KENYA**

**COMPETENCY BASED CURRICULUM**

**FOR**

**MECHANICAL TECHNOLOGY AND MAINTENANCE**

**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/CU/MEM/BC/01/6/B**

Industry or sector

Curriculum

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 |

WIBA Welfare and Injury Benefits Act

# OVERVIEW

This course is designed to equip the Mechanical Technology and Maintenance Technician with the competencies to perform Bench Work, Manual Metal Arc Welding, Oxy-acetylene gas welding and cutting, Perform Lathe operations, Perform equipment and machine maintenance, install machines and equipment, Maintain Hydraulic and Pneumatic systems and maintain Pumps and Air compressors using good maintenance practices and standard operating procedures.

The Mechanical Technology and Maintenance Technician assist engineers in developing, building, or testing prototypes or new products, processes, or procedure assist and monitor and adjust maintainance 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/MEM/BC/01/6/B | Demonstrate  communication  skills | 40 | 4 |
| ENG/CU/MEM/BC/02/6/B | Demonstrate digital literacy | 60 | 6 |
| ENG/CU/MEM/BC/03/6/B | Demonstrate understanding of entrepreneurship | 100 | 10 |
| ENG/CU/MEM/BC/04/6/B | Demonstrate employability skills | 80 | 8 |
| ENG/CU/MEM/BC/05/6/B | Demonstrate environmental literacy | 40 | 4 |
| ENG/CU/MEM/BC/06/6/B | Demonstrate occupational and health safety practices | 40 | 4 |
| **TOTAL** | | **360** | **36** |

**Common Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning Code** | **Unit of Learning**  **Title** | **Duration in Hrs.** | **Credit factor** |
| ENG/CU/MEM/CC/01/6/B | Technical drawing | 150 | 15 |
| ENG/CU/MEM/CC/02/6/B | Engineering Mathematics | 150 | 15 |
| ENG/CU/MEM/CC/03/6/B | Mechanical Science Principles | 75 | 7.5 |
| ENG/CU/MEM/CC/04/6/B | Fluid Mechanics Principles | 75 | 7.5 |
| ENG/CU/MEM/CC/05/6/B | Thermodynamics principles | 75 | 7.5 |
| ENG/CU/MEM/CC/06/6/B | Material science and metallurgical processes | 75 | 7.5 |
| ENG/CU/MEM/CC/07/6/B | Electrical Principles | 75 | 7.5 |
| **TOTAL** | | **675** | **67.5** |

**Core Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning**  **Code** | **Unit of Learning**  **Title** | **Duration in Hrs.** | **Credit factor** |
| ENG/CU/MEM/CR/01/6/B | Perform bench work operations | 100 | 10 |
| ENG/CU/MEM/CR/02/6/B | Perforrm Manual Metal Arc Welding | 140 | 14 |
| ENG/CU/MEM/CR/03/6/B | Perform Oxy-Acetylene Gas Welding and cutting | 100 | 10 |
| ENG/CU/MEM/CR/04/6/B | Perform Lathe Operations | 140 | 14 |
| ENG/CU/MEM/CR/05/6/B | Install Machine / equipment | 150 | 15 |
| ENG/CU/MEM/CR/06/6/B | Perform machine /equipment maintenance | 165 | 16.5 |
| ENG/CU/MEM/CR/07/6/B | Maintain hydraulic and pneumatic sytems | 200 | 20 |
| ENG/CU/MEM/CR/08/6/B | Maintain pumps and air compressors | 200 | 20 |
|  | Industrial Attachment | 480 | 48 |
| **TOTAL** | | **1675** | **167.5** |
| **GRAND TOTAL** | | **2710** | **271** |

**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 Technology and maintenance 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 Technology and Maintenance Technician Diploma qualification . These certificates will be issued by TVET CDACC in conjunction with training provider.

# BASIC UNITS OF LEARNING

## DEMONSTRATE COMMUNICATION SKILLS

**UNIT CODE: ENG/CU/MEM/BC/01/6/B**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Demonstrate communication skills**

**Duration of Unit:** 40hours

**Unit Description**

This unit describes the competencies required to use specialized communication skills to meet specific needs of internal and external clients, conduct interviews, facilitate discussion with groups and contribute to the development of communication strategies.

**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 discussions
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 | * Observation * Oral * Written |
| 1. Develop communication strategies | * Dynamics of groups * Styles of group leadership * Openness and flexibility in communication * Communication skills relevant to client groups | * Written * Observation * Oral |
| 1. Establish and maintain Communication pathways | * Pathways of communication * Requirements of the organization * Review | * Written * Observation * Oral |
| 1. Promote use of communication strategies | * Application of elements of communication strategies * Effective communication techniques | * Written * Observation |
| 1. Conduct interviews | * Types of interview * Establishing rapport * Facilitating resolution of issues * Developing action plans | * Written * Observation |
| 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 | * Written * Observation |
| 1. Represent the organization | * Presentation techniques * Development of a presentation * Multi-media utilization in presentation * Communication skills relevant to client groups | * Observation * Written |

**Suggested Delivery Methods**

* Interview
* Role playing
* Observation
* Viewing of related videos

**Recommended Resources**

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

**DEMONSTRATE DIGITAL LITERACY**

**UNIT CODE: ENG/CU/MEM/BC/02/6/B**

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: **Demonstrate digital literacy**

**Duration of Unit:** 80 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 in automated environment | * 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
* Field work

**Recommended Resources**

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

**DEMONSTRATE UNDERSTANDING OF ENTREPRENEURSHIP**

**UNIT CODE: ENG/CU/MEM/BC/03/6/B**

**Relationship to occupational standards**

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

**Duration of unit:** 80 hours

**Unit description**

This unitof competence describes the competencies critical to demonstration of understanding capabilities of an entrepreneur,entrepreneurship and self employment,entrepreneurship, indentifying entrepreneurship opportunities, and creating entrepreneurial awereness. Entrepreneurial motivation,innovative business strategies,development of innovative business strategies and business plan.

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Demonstrate understanding of an entrepreneur | * Entrepreneurial skills development * Market trends * Monitoring and anticipating market trends * New technologies in entrepreneurship * Products and processes in entrepreneurship * Linkages with other entrepreneurs * Business conventions ad exhibitions * Personal improvement and growth | * Observation * Case studies * Individual/group assignments * Projects * Written * Oral |
| 1. Demonstrate understanding of entrepreneurship and self employment | * Good quality staff/workers * Principles of entrepreneurship * Self employment requirements * Team building and team work * Staff development and enhancement * Culture of continuous improvement * Increasing products and services * Marketing improvement * Intrapreneurship | * Observation * Case studies * Individual/group assignments * projects * Written * Oral |
| 1. Identify entrepreneurship opportunities | * Sources of business ideas * Opportunities * Business live cycle * Legal aspects * Product demand * Business environment * Technology in business. | * Oral * Observation * Case studies * Individual/group assignments * projects * Written |
| 1. Create entrepreneurial awareness | * Forms of business * Source of business finance * Governing policies on small scale entreprises * Problems in small scale enterprises | * Observation * Case studies * Individual/group assignments * projects * Written |
| 5.Apply entrepreneurial motivation | * Internal motivation * External motivation * Motivational theories * Entrepreneurial motivation * Communication principles | * Oral * Observation * Case studies * Individual/group assignments * projects * Written |
| 6.Develop and implement innovative business strategies | * Business innovation strategies * Creativity * Linkages with entrepreneurs * ICT integration | * Oral * Observation * Case studies |
| 7.Develop and implement business plan | * Business identification procedures and strategies * Marketing plan * Organization/management plan * Production/ operation plan * Financial plan * Excutive summary * Presentation of business plan | * Oral * Observation * Case studies * Project * Written |

**Suggested Delivery Methods**

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

**Recommended Resources**

* Case studies for small businesses
* Checklists
* Research tools(questionares, interview guide and observation guide)
* Business plan templates
* Lap top/ desk top computer
* Internet
* Telephone
* Writing materials
* Reference materials

**DEMONSTRATE EMPLOYABILITY SKILLS**

**UNIT CODE:** **ENG/CU/MEM/BC/04/6/B**

**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. Demonstrate workplace ethics

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

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

**Suggested Methods of Delivery**

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

**Recommended Resources**

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

**DEMONSTRATE ENVIRONMENTAL LITERACY**

**UNIT CODE:**  **ENG/CU/MEM/BC/05/6/B**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **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 and monitor activities on environmental protection/programs.

**Summary of Learning Outcomes**

1. Control environmental hazard
2. Demonstrate environmental pollution control
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 * Purposes and content of Solid Waste Act * Storage methods for environmentally hazardous materials * Disposal methods of hazardous wastes * Types and uses of PPE in line with environmental regulations * Occupational Safety and Health Standards (OSHS) | * Written questions * Oral questions * Observation of work procedures |
| 1. Control environmental Pollution | * 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 * Project |
| 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 * Projects |
| 1. Monitor activities on Environmental protection Programs | * Periodic monitoring and Evaluation of activities * Gathering feedback from stakeholders * Analysing data gathered * Documentation of recommendations and submission * Setting of management support systems to sustain and enhance the program * Monitoring and reporting of environmental incidents to concerned /proper authorities | * Oral questions * Written tests * Practical * Observation * Project |
| 1. Analyse resource use | * Resources * Quantity * Nature * Processes * Resource flow analysis * Waste classification | * Oral questions * Written tests * Practical test * Observation * Projects |
| 1. Develop resource conservation plans | * Efficiency use/conversion * Industrial Flow protocol * Cases of low efficiency * Resource efficiency plans | * 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
* Field work

**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
* Reference materials

**DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES**

**UNIT CODE:** **ENG/CU/MEM/BC/06/6/B**

**Relationship to Occupational Standards**

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

**Duration of Unit:** 50 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 risks
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 is conducted by * Authorized personnel or agency * Gathering of OHS issues and/or concerns raised | * Oral questions * Written tests * Observation |
| 1. Identify and implement control measure to hazards and risks | * Prevention and control measures, including use of PPE (personal protective equipment) for specific hazards are identified and implemented * Appropriate risk controls based on result of OSH hazard evaluation is recommended * Contingency measures, including emergency procedures during workplace incidents and emergencies are recognized and established in accordance with organization procedures | * Oral questions * Written tests * Practical test * Observation |
| 1. Implement OSH   programs, procedures  and policies/guidelines | * Providing information to work team about company OHS program, procedures and policies/guidelines * Participating in implementation of OSH procedures and policies/ guidelines * Training of team members and advice on OSH standards and procedures * Implementation of procedures for maintaining OSH-related records | * Oral questions * Written * Practical * Observation |

**Suggested Delivery Methods**

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

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Machine/equipment manufacturer’s specifications and instructions
* Reference materials
* 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

## PREPARE AND INTERPRET TECHNICAL DRAWINGS

**UNIT CODE:** ENG/CU/MEM/CC/01/6/B

**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 maintenance technician. It involves competencies to select, use and maintain drawing equipment and materials. It also involves producing plane geometry drawings, solid geometry drawing,orthographic and pictorial drawings of components and produce assembly drawings and applying CAD packages in drawing.

**Summary of Learning Outcomes**

1. Use and maintain drawing equipment and materials
2. Produce plane geometry drawings
3. Produce solid geometry drawings
4. Produce orthographic and pictorial drawings of components
5. Produce assembly drawings
6. Apply CAD packages in drawing

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Use and maintain drawing equipment and materials | * Identification, use and maintenance of drawing equipment and materials | * Observation * Oral * Written tests * Practicals |
| 1. Produce plane 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 * Written tests * Observation * Practicals |
| 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 * Practicals |
| 1. Produce orthographic and pictorial 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 | * Explanation of orthographic views * Explanation of pictorial views * Identification and listing of parts * Production of sectional views * Hatching of drawings | * Observation * Written test * Oral test * Practicals |
| 1. Apply CAD packages in drawing | * Introduction to CAD * Application of CAD packages | * Observation * Written test * Oral test * Practicals * Projects |

**Suggested Methods of Delivery**

* Instructor led facilitation
* Projects
* Demonstration by trainer
* Practice by the trainee
* Field trips
* Group discussions
* Direct instructions

**Recommended Resources**

* + Drawing room
  + PPEs
  + Computer lab
  + Drawing boards.
  + Drawing papers (A4 and A3)
  + Drawing equipment and materials
  + Overhead projector

## APPLY ENGINEERING MATHEMATICS

**UNIT CODE:** ENG/MEM/CC/02/6/B

**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 * Supervised exercises |

|  |  |  |
| --- | --- | --- |
| 2. Apply Trigonometry 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 |

|  |  |  |
| --- | --- | --- |
|  | 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. * Estimation of errors of small changes using binomial theorem. | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 6. Apply Calculus | * Definition of derivatives of a function * Differentiation from first 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 |
| 9. Apply Power Series | * Definition of the term power series * Taylor’s theorem * Deduction of   Maclaurin’s theorem to obtain power series   * Application of Taylor’s theorem and Maclauurin’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   * Data presentation * Application of probability distributions | * Assignments * Oral questioning * Supervised exercises * Written tests * Simulation * Data modelling * Practical |
| 11. Apply  Numerical  methods | * Definition of interpolation and extrapolation * Application of interpolation * Application of iteractive methods to solve equations * Application of iteractive methods to areas and volumes | * Assignments * Oral questioning * Supervised   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
* Instructor led facilitation

**Recommended Resources**

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

**APPLY MECHANICAL SCIENCE PRINCIPLES**

**UNIT CODE:** ENG/CU/MEM/CC/03/6/B

**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. Demonstrate understanding of friction principles
4. Demontrate understanding of motions in engineering
5. Determine work, energy and power
6. Perform machine calculations
7. Demonstrate understanding of gas principles
8. Apply heat principles
9. Apply density principles
10. Apply pressure principles

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 1. Determine  forces in a  system | * Definition of force * State and explain force theorems * Calculation of resultant of co-planar forces * Resolution of forces * Calculation of the resultant force and equilibrium * Application of different forces | * Written tests * Oral   questioning   * Assignments * Supervised exercises |
| 2. Demonstrate knowledge of moments | * Definition of moments * Principle of moments * Calculation of couples * Calculation of moments of   a force, | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 3. Demonstrate undersanding of friction  principles | * Definition of friction * Advantages and Disadvantages of friction * Laws of friction * Coefficient of friction * Limitting of friction * Forces applied at an angle | * Assignments * Oral questioning * Supervised exercises * Written tests |
| 4. Demonstrate understanding of motions in engineering | * Linear motion * Angular motion * Equations of motion * Laws of motions * Motion calculations * Displacement time graphs * Application of motions | * Assignments * Oral   questioning   * Practical tests * Observation * Supervised exercises * Written tests | |
| 5. Determine work, energy and power | * Definition * Work, * Energy * Power * Principles of conservation of energy * Applications | * Assignments * Supervised exercises * Written tests * Practical test | |
| 6. Perform machine calculations | * Definition of machine * Simple machines * 1st ,2nd and 3rd class levers * Law of machine calculation * Fundamentals of a machine * Dimensional units 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 | |
| 7. Demonstrate understanding of gas principles | * Definitions * Gas laws * Application of gas equations | * Assignments * Supervised exercises * Written tests * Practical test | |
| 8. Apply heat principles | * Meaning of heat * Methods of heat transfer * Conduction * Convection * Radiatioin * Heat calculations * Quantity of heat * Heat in mixtures * Water equivalent mass * Latent heat * Fusion * Vaporisation * Applications | * Assignments * Supervised exercises * Written tests * Practical test | |
| 9. Apply density principles | * Meaning of density * Density calculations * Application of density principles | * 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
* Instructor led facilitation
* Exercises by trainee

**Recommended Resources**

* Scientific Calculators
* Relevant reference materials
* Stationeries
* Electrical workshop
* Relevant practical materials
* Measuring tools and equipment
* Computers with internet connection

## APPLY FLUID MECHANICS PRINCIPLES

**UNIT CODE:** ENG/CU/MEM/CC/04/6/B

**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 demonstrating understanding of flow in fluids, demonstrating knowledge in viscous flow, performing dimensional analysis and operating fluid pumps

**Summary of Learning Outcomes**

1. Demonstrate understanding of flow in 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. Demonstrate (concept) understanding of flow in fluids |  | * Flow rate in pipes * Determination of Losses in pipes * 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 * Practical |
| 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   pump equation   * Deriving Centrifugal pump equation * Application of Pump equation in problem solving | * Assignments * Oral   questioning   * Practical tests * Observation * Supervised exercises * Written tests |

**Suggested Delivery Methods**

* + Group discussions
  + Demonstration by trainer
  + Instructor led facilities
  + Exercises by trainee

**Recommended Resources**

* + Scientific Calculators
  + Relevant reference materials
  + Stationeries
  + Relevant practical materials
  + Diceasuring tools,apparatus ,equipment and sample materials
  + Computers
  + Internet connection

## APPLY THERMODYNAMICS PRINCIPLES

**UNIT CODE:** ENG/CU/MEM/CC/05/6/B

**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 demonstrate understanding of 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. Demonstrate understanding of fundamentals of thermodynamics
2. Demonstrate understanding of steady flow processes
3. Demonstrate understanding of non-steady flow processes
4. Demonstrate understanding of perfect gases
5. Demonstrate understanding of steam generation
6. Perform thermodynamics reversibility and demonstrate understanding of entropy
7. Demonstrate understanding of ideal gas cycles
8. Demonstrate understanding of fuel and combustion
9. Demonstrate understanding of heat transfer
10. Demonstrate understanding of heat exchangers
11. Demonstrate understanding of air compressors
12. Demonstrate understanding of gas turbines
13. Demonstrate understanding of impulse steam turbines

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Learning Outcome** | |  | | **Content** |  | | | | **Suggested**  **Assessment Methods** |
| 1. Demonstrate understanding of fundamentals of  thermodynami  cs | |  | | Terms used in thermodynamics Thermodynamic processes and cycles First law of thermodynamics |        | | | | Written tests Oral questioning Assignments Supervised exercises  Practicals |
| 2. Demonstrate understanding of steady flow processes | |  | | * Derivation of Steady flow energy equation Applying Steady flow energy equation * Application of Steady flow energy equation in utilities |  | | | | * Written tests * Oral questioning * Assignment * Supervised exercises |
| 3.Demonstrate understanding of non steady flow processes | |  | | * Derivation of non-flow energy equation * Application of Non-flow energy equation in problem solving |  | | | | * Assignments * Oral questioning * Supervised exercises * Written tests |
| 4. Demonstrate understanding of perfect gases | | * Perfect gas laws * Carry out Gas laws Experiment * Application of Gas laws | | | * Assignments * Oral questioning * Supervised exercises * Written exercises | | | | |
| 5. Demonstrate understanding of steam generation | |  | * 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 * Written 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. Demonstrate understanding of gas cycles | |  | * Ideal gas cycle processes Air standard efficiency and actual efficiency are differentiated * Problems are solved in ideal gas cycle | | *  *  | | * Assignments Oral questioning | | |
| 8. Demonstrate understanding of 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. Demonstrate understanding of 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. Demonstrate understanding of heat exchangers |  | | * Classification of Heat exchangers * Recuperative heat exchangers are described Application of Heat equations | | | *  *  *  *  *  | | * Assignments * Oral questioning Practical tests * Observation Supervised exercises | |
| 11. Demonstrate understanding of 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 | |
| 12. Demonstrate understanding of 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. Demonstrate understanding of impulse steam turbines |  | | * Principles of operations of the impulse steam turbines * Deriving and applying Impulse steam turbine equation | | | *  *  *  *  | | * Assignments * Oral questioning * Practical tests * Observation | |
|  |  | |  | | |  | |  | |

**Suggested Delivery Methods**

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

**Recommended Resources**

* Scientific Calculators
* Relevant reference materials
* Stationeries
* Relevant practical materials
* Computers with internet connection
* Tools and equipment i.e. gas turbines, impulse steam turbines

## APPLY MATERIAL SCIENCE AND METALLURGICAL PROCESSES

**UNIT CODE:** ENG/MEM/CC/06/6/B

**Relationship to Occupational Standards**

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

**Duration of Unit:** 75 hours

**Unit Description:**

The trainee will be introduced to performing material testing and metallurgical processes. It involves identifying properties of engineering materials, demonstrate understanding of extraction processes, iron materials, ceramics, composites and alloys, performing heat treatment, material testing and identifying corrosion and its prevention

**Summary of Learning Outcomes**

1. Identify properties of engineering materials
2. Demonstrate understanding of ore extraction processes
3. Demonstrate understanding of production of ferrous materials
4. Demonstrate understanding of production of non-ferrous materials
5. Demonstrate understanding of alloys
6. Demonstrate understanding of production of ceramics
7. Demonstrate understanding of composite materials production
8. Demonstrate understanding of heat treatment processes.
9. Perform material testing
10. Prevent material corrosion

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Learning Outcome** |  | **Content** | **Suggested**  **Assessment Methods** | |
| 1. Identify properties of engineering materials |  | * Identification of Engineering materials * Physical properties of engineering materials * Mechanical properties of engineering materials * Crystal structure of materials | * Written tests * Oral questioning * Assignments * Supervised exercises | |
| 2. Demonstrate understanding of ore extraction processes |  | * Safety measures in metal extraction * Methods of metal extraction * Procedure in metal extraction processes Storing of metal Extraction bi- products * Disposing extraction bi- products | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical | |
| 3. Demonstrate understanding of production of ferrous materials |  | * Ore smelting processes. * Composition of iron Method of producing iron material * Refinement processes | * Written assessment * Oral * Assignments * Supervised exercises | |
| 4. Demonstrate understanding of production of non-ferrous materials |  | * Extraction of Non-ferrous materials * Smelting and purifying of extracted non-ferrous material * Testing Non-ferrous material * Non ferrous materials | * Assignments * Oral questioning * Practical tests * Observation | |
| 5.Demonstrate understaind of alloys |  | * Identifying Alloying elements for non-ferrous materials * Alloy formation process Testing of Alloys for * Testing alloy products quality | * Assignments * Supervised exercises * Written tests * Practical test | |
|  |
| 6. Demonstrate understanding of production of ceramics |  | * 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. Demonstrate understanding of composite |  | Types of composites Elements involve in composite formation | * Assignments * Supervised exercises | |
| materials production |  | * Formation process of composites * Testing of composite materials | *  *  | Written tests  Practical test |
| 8. Demonstrate understanding of heat treatment processes |  | * Safety practices procedures Heat treatment processes Procedure in heat treatment * processes *  Operations of heat treatment of metals | *  *  *  *  | Assignments Supervised exercises Written tests  Practical test |
| 9.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 |
| 10. Prevent material Corrosion |  | * Safety observation during corrosion prevention * Corrosion types * 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
* Instructor led facilitation

**Recommended Resources**

Tools and equipment

* Measuring tools and gauges
* Marking out tools
* Inspection tools and equipment
* Material testing equipment/machine
* Heating equipment
* Firefighting equipment Materials and supplies
* PPEs –dust coat, dust masks, ear muffs, goggles
* First Aid kit
* Brooms and cleaning equipment
* Cleaning detergents
* Drawing papers
* Specimen materials
* Scrap metals

## APPLY ELECTRICAL PRINCIPLES

**UNIT CODE:** ENG/CU/MEM/CC/07/6/B

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Apply Electrical 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 Electrical principles in their work; use the concept of basic Electrical quantities, use the concepts of D.C and A.C circuits in electrical installation, use of basic electrical machine, use of earthing in Electrical installations and apply lightning protection measures

**Summary of Learning Outcomes**

1. Use the concept of basic Electrical quantities
2. Use the concepts of D.C and A.C circuits in electrical installation
3. Use basic electrical machine
4. Use earthing in Electrical installations
5. Apply lightning protection measures

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Use the concept of basic Electrical quantities | * The meaning of SI unit * SI unit of various types of Electrical parameters * Ohm’s law * Calculations involving various Electrical parameters e.g Power, Current, Voltage, Resistance * Instruments used in measuring various types of Electrical parameters | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. Use the concepts of D.C and A.C circuits in electrical installation | * Meaning of terms * AC and DC, parallel and series circuits * AC and DC network theorems * AC to DC and DC to AC Conversion * Basic solar photovoltaic systems | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. Use basic electrical machine | * Types of Electrical machines * DC machines, * AC Single and three phase motors, generators and Transformers * Application of AC and DC machines * Special machines and their Applications * Electric Drives | * Assignments * Oral questioning * Supervised exercises * Written tests * Practical tests |
| 1. Use earthing in Electrical installations | * + Meaning of Earthing   + Terms in Earthing   + Earthing points in Electrical installation   + Methods of earthing   + Factors to consider in selecting an earthing method   + Testing an earthing system | * Assignments * Supervised exercises * Written tests * Practical test |
| 1. Apply lightning protection measures | * + Meaning of lightning   + Lightning strikes and their types   + Lightning protection components   + Testing a lightning system   + Application of lightening system   + Maintenance of lightning system | * Assignments * Oral questioning * Supervised exercises * Written tests |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Practice by trainee
* Instructor led facilition

**Recommended Resources**

* Scientific Calculators
* Relevant reference materials
* Stationeries
* Electrical workshop
* Relevant practical materials
* Computers
* Internet connection

# CORE UNITS OF LEARNING

## PERFORM BENCH WORK OPERATIONS

**UNIT CODE:** ENG/CU/MEM/CR/01/6/B

**Relationship to Occupational Standards**:

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

**Duration of Unit:** 100 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 performing housekeeping.

**Summary of Learning Outcomes**

1. Observe safety rules and regulations
2. Prepare operation plan
3. Measure and mark out dimensions on work pieces
4. Clamp work pieces on holding devices
5. Use hand and power tools
6. Assemble parts and sub-assemblies
7. Perform finishing on components
8. Inspect finished work
9. Maintain tools and equipment
10. Perform housekeeping tasks

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** |
| 1. Observe safety rules and regulations | * General safety * Safely use of PPE’s(Overall, gloves, eye shield, head cap, safety shoes, ear   masks)   * Machine/equipment safety * Current Occupational safety and health act * Current WIBA act | * Administration of written and oral tests * Assessment of worksheet/ operation plans |
| 2. Prepare operation plan | * Technical drawing and geometric symbols are interpreted. * Drawing standards * Operational plan (type of operation, time required, materials required and tools required) | * Observation * Administration of oral and written questions |
| 3. 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 |
| 4. Clamp 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) |
| 5. Use hand and power tools. | * Types of hand and power tools * Uses of hand and power 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 |
| 6. Assemble  parts and sub-assemblies | * 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 |
| 7. Perform finishing on components | * Finishing methods includes: * Polishing * Filing * Lapping * Etching * Painting * Sanding * Sand blasting * Degree of surface texture | * Observation of   Finishing processes   * Oral * Written questions. * Practical * Project |
| 8.Inspect finished work | * Inspection tools * Calibrations * Inspection procedures * Adjustments | * Observation * Oral questions * Written questions |
| 9.Maintain tools and equipment | * Tools and equipments * Inspection of tools and equipments * Repairs * Lubrication * Reporting on faults | * Observation * Oral questions * Written questions * Practcals |
| 10. Perform housekeeping tasks | * Cleaning * Waste disposal * Storage methods | * Observation * Oral questions * Written questions |

**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
* Dust pans
* Dust bins/ Dust bin liners
* Dusters
* Cleaning agents and detergents
* Mops/ Brooms/ Brushes and buckets
* Storage equipment
* 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 agents and detergents

## PERFORM MANUAL METAL ARC WELDING

**UNIT CODE:** ENG/CU/MEM/CR/02/6/B

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards**:** **Perform 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. Observe safety rules and regulations
2. Identify parts of manual metal arc welding machine
3. Demonstrate understanding of manual metal arc welding principles
4. Identify weld joints and positions
5. Prepare workpiece
6. Set up of arc welding parameters machine
7. Perform manual metal arc welding
8. Inspect the weld
9. Maintain the manual ,metal arc welding machine
10. Perform housekeeping tasks

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Learning Outcome** | | **Content** | | **Suggested**  **Assessment**  **Methods** |
| 1. Observe safety rules and regulations | | * General workshop 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.) * Current Occupational safety and health act * Current WIBA Act * Current National Environment Management Authority   Act, Kenya | | * Observation of use of PPEs * Observation of safe working procedures and operations * Administration of oral and   written tests   * Administration of simulated tests |
| 2. Identify parts of manual metal arc welding machine | | * Parts of a manual metal arc welding machine * Functions of manual metal arc welding machine parts | | * Administration of written and   oral test   * Administration of simulated tests |
| 3.Demonstrate understanding of manual metal arc welding principles | | * AC/DC manual metal arc welding * Arc generation * Welding parameters | | * Observation * Administration of written and   oral test   * Administration of simulated tests |
| 4. Identify weld joints and positions | | * Types of welding joints * Welding joint symbols * Profile of a weld * Types of welding position * Flat * Overhead * Vertical * Horizontal | | * Observation * Administration of written and   oral test   * Administration of simulated tests |
| 5. Prepare work piece | | * Laying out work piece(s) * Marking of dimensions * Measuring,marking out and hand tools * Joint cleaning methods * Joint geometry * Types of joints | | * Observation * Administration of written and   oral test   * Administration of simulated tests |
| 6. Set up the arc welding parameters | | * AC/DC Setting * Polarity and cable connection * Straight polarity * Reverse polarity * Setting parameters * Amperage * Thickness * Voltage | | * Administration   of oral and  written tests   * Observation of connection cables/leads, set up parameters |
| 7.Perform manual metal arc welding | | * Tack weld * Root gap adjustment * Alignment and clamping * Welding process * Post-weld cleaning * Joint symbols * Weld positions * Root run | | * Administration   of oral and  written tests   * Observation of connection cables/leads, set up parameters |
| 8.Inspect the weld | * Measuring * Surface finishing * Functionality * Weld defects * Weld tests * Non-destructive testing and inspection * Destructive testing and inspection | | * Administration   of oral and  written tests  Observation of connection cables/leads, set up parameters | |
| 9. Maintain the manual metal arc welding machine | Disconnecting welding machine after operations   * Inspect the machine * Servicing of welding machine * Cleaning of welding machine * Machine Faults are reported | | * Observation of cleaning of welding machine * Observation of servicing and maintenance of the welding machine * Administration of oral and   written tests | |
| 10. Performing  housekeeping tasks | * Cleaning of work environment (waste sorting and disposal) * Cleaning and storing of tools and equipment   Cleaning of welding bay | | * Observation * Practicals | |

**Suggested Delivery Methods**

* Instructor led facilitation
* Demonstration by trainer
* Discussions
* Practical work by trainee(s)
* Group work
* Industrial visits/Field work
* YouTube for teaching/learning and inspiration
* Simulation

**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
* Audio visual equipment

**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 agents and detergents
* Drawing papers (A4 and A3)
* Working drawings
* Operation sheets/ templates
* Electrodes

## PERFORM OXY- ACETYLENE GAS WELDING AND CUTTING

**UNIT CODE:** ENG/CU/MEM/CR/03/6/B

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards**:** **Perform oxy-acetylene gas welding and cutting**

**Duration of Unit:** 100 Hours

**Unit Description**

This unit describes occupational standards for perform oxyacetylene gas welding and cutting. The technician will be able to use different techniques in oxyacetylene gas welding and cutting 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. Observe safety rules and regulations in the workshop
2. Identify parts of oxyacetylene gas welding equipment
3. Demonstrate understanding of oxyacetylene gas welding and cutting
4. equipment principles
5. Identify weld joints and techniques
6. Prepare workpiece
7. Set up oxyacetylene gas welding and cutting parameters
8. Perform gas welding and cutting
9. Inspect finished work
10. Maintain oxyacetylene gas welding and cutting equipment
11. Perform housekeeping tasks

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Learning Outcome** | | **Content** | | **Suggested**  **Assessment**  **Methods** |
| 1. Observe safety rules and regulations in the workshop | | * General workshop 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. Identify parts of oxy-acetylene gas welding and cutting equipment | | * Parts of a oxyacetylene gas welding and cutting equipment * Function of oxyacetylene gas welding and cutting equipment parts | | * Administration of written and   oral test   * Administration of simulated tests * Observation |
| 3.Demonstrate understanding of oxy-acetylene gas welding and cutting principles | | * Oxygen and acetylene cylinders * Pressure regulation * Gas ratios * Lighting the blow torch * Cutting principle * Nozzles * Shutting down principle * Types of flames | | * Observation * Administration of written and   oral test   * Administration of simulated tests |
| 4. Identify weld joints and techniques | | * Types of welding joints * Welding joint symbols * Profile of a weld * Types of welding techniques * Leftward/forehand technique * Rightward/backhand technique | | * Observation * Administration of written and   oral test   * Administration of simulated tests |
| 5. Prepare work piece | | * Laying out work piece(s) * Marking of dimensions * Measuring,marking out and hand tools * Joint cleaning methods * Joint geometry * Types of joints | | * Observation * Administration of written and   oral test   * Administration of simulated tests |
| 6. Set up gas welding and cutting parameters | | * Setting up of oxy-acetylene gas welding equipment * Setting up work pieces * Setting up parameters * Type and size of nozzle * Type of material * Thickness of material | | * Administration * of oral and * written tests * Observation of set up parameters |
| 7.Perform oxy-acetylene gas welding and cutting | | * Tack weld * Root gap adjustment * Alignment and clamping * Welding process * Flame-cutting process * Post-weld cleaning * Post-cutting cleaning * Joint symbols * Weld positions | | * Administration   of oral and  written tests   * Observation of set up parameters |
| 8.Inspect the finished work | * Leak testing * Measuring * Surface finishing * Functionality * Weld defects * Weld tests * Quality of cutting * Non-destructive testing and inspection * Destructive testing and inspection | | * Administration   of oral and  written tests   * Observation of set up parameters | |
| 9. Maintain the oxyacetylene gas welding and cutting equipment | * Equipments and tools are inspected * Release hose pressure * Inspect the equipment * Servicing of welding equipment * Cleaning of equipment * Equipment Faults are reported | | * Observation of cleaning of welding machine * Observation of servicing and maintenance of the welding machine * Administration of oral and   written tests | |
| 10. Performing housekeeping tasks | * 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**

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

**Recommended Resources**

**Tools & Equipment**

* Measuring tools
* Marking out tools
* Oxyacetylene gas welding equipment
* Cutting torch
* Marking out tools
* Inspection tools and equipment
* Angle grinder
* Work benches
* Bench vices
* Wire brush
* File card
* Firefighting equipment
* Electrode cabinet/oven
* Jigs and fixtures
* Audio visual equipment

**Materials and supplies**

* PPEs – dust coat, leather, face shield, spats, gloves, safety boots, goggles
* Raw materials
* GI pipes
* Mild steel sheets
* Flux
* First Aid kit
* Brooms and cleaning stuff
* Cotton waste
* Cleaning detergents
* Drawing papers
* Working drawings
* Operation sheets/ templates
* Filler rods

## PERFORM LATHE OPERATIONS

**UNIT CODE:** ENG/CU/MEM/CR/04/6/B

**Relationship to Occupational Standards**

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

**Duration of Unit:** 140 hours

**Unit Description**

The trainee 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. Observe workshop safety rules and regulations
2. Identify lathe machine parts and their functions
3. Prepare operation plan
4. Set up machine tool
5. Perform machining operations
6. Inspect finished work
7. Maintain the machine tool and accessories
8. Performing housekeeping tasks

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Learning Outcome** | **Content** | | **Suggested**  **Assessment**  **Methods** | |
| 1.Observe safety rules and regulations | * General safety * Use of PPE’s (Overall, eye shield, safety shoes) * Machine safety * Current Occupational safety and health act * Current OSH act * Workshop rules and regulations * Safe working environment (workshop layout, waste sorting and disposal) | | * Observation * Oral and written tests | |
| 2. Identify lathe machine parts and their functions | * Types of lathe machines * Parts of a lathe machine * Functions of the parts of a lathe machine * Methods of specifying the lathe machine | | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 3.Prepare operation plans | * Types of operations * Sequence of operations * Speeds and feeds * Types of tools * Machining time * Depth of cut | | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 4.Set up machine tools | | * Cutting tools * Speed and speed selction * Work holding devices * Tool holding * Tool setting | | * Administration of written and   oral test   * Administration of simulated tests * Observation |
| 5. Perform machining operations | | * Facing * Surface turning * Step turning * Thread cutting * Taper turning * Knurling * Boring * Drilling * Chamfering * Parting-off | | * Administration of written and   oral test   * Administration of simulated tests * Observation * Practicals |
| 6.Inspect finished work | | * Measuring * Surface texture * Functionality * Tolerances | | * Administration of written and   oral test  Practicals  Observation |
| 7. Maintain the lathe machine tool and accessories | | * Cleaning lathe tool after operations * Servicing and maintenance of lathe (lubrication, inspection, alignment and adjustment, coolant, safety guard) | | * Observation * oral * written tests * Practicals |
| 8. Perform housekeeping tasks | | * 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**

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

**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, attachments and accessories
* Firefighting equipment
* Assorted gauges
* Assorted cutting tools
* Audio visual equipment

**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

## INSTALL MACHINE / EQUIPMENT

**UNIT CODE:** ENG/CU/MEM/CR/05/6/B

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Install machine/ equipment**

**Duration of Unit:** 150 hours

**Unit Description**

This unit covers the competencies required to install mechanical machine /equipment. It involves competencies to observe occupational health and safety, interpret installation manual, obtain work permit for authorization, prepare for installation, install machine/equipment, test and commission installation and perform housekeeping.

**Summary of Learning Outcomes**

1. Observe safety rules and regulations
2. Interpret the installation manual
3. Obtain work permit for authorization
4. Prepare for installation
5. Install machine /equipment
6. Demonstrate testing and commissioning procedures
7. Performing housekeeping

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Learning Outcome** | **Content** | | **Suggested**  **Assessment**  **Methods** |
| 1.Observe safety rules and regulations | * Use of PPE’s (Overall, eye shield, safety shoes) * Machine safety * Current Occupational safety and health act * Current OSH act * Workshop rules and regulations * Safe working environment | | * Observation of use of PPEs * Observation of safe working procedures and operations * Administration of oral and written tests |
| 2. Interpret the installation manual | * Machine specifications * Machine assembly diagram | | * Administration of written and   oral test   * Administration of simulated tests * Observation |
| 3.Obtain work permit for authorization | * Application documents * Certification of application documents * Payment for application * Presentation of certified documents * Work permit | | * Administration of written and   oral test   * Administration of simulated tests * Observation |
| 1. Prepare for installation | | * Types of machines/equipment and systems * Hydraulics * Pneumatics * Pumps * Air compressors * Machine tools * Blowers * Equipment * Installation requirements * materials * supplies * Installation parameters * Dimensions * Location * Level * Non-compliance reports * Corrections * Site preparation | * Administration of written and   oral test   * Administration of simulated tests * Observation |
| 5. Install machine/equipment | | * Installation safety * Installation manual requirements * Installation tools * Installation procedure * Installation checks * Installation documentation | * Administration of written and   oral test   * Administration of simulated tests * Observation |
| 6.Demonstrate understanding of testing and commissioning procedures | | * Testing tools and equipment * Testing procedure * Calibration * Training of operators * Commission procedure | * Administration of written and   oral test   * Administration of simulated tests * Observation |
| 7.Perform housekeeping tasks | | * 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 |

**Suggested Delivery Methods**

* Instructor led facilitation
* Demonstration by trainer
* Discussions
* Practical work by trainee(s)
* Group work
* Industrial visits/Field work
* YouTube for teaching/learning and inspiration
* Simulation

**Recommended Resources**

**Tools & Equipment**

* Measuring tools
* Marking out tools
* Hand tools
* Inspection tools and equipment
* Work benches
* Firefighting equipment
* Material handling equipment
* Tool box
* Machine tools

**Materials and supplies**

* PPEs – dust coat, safety boots, goggles
* Fasteners(draw bolts, rivets, nuts and bolts,screws,keys, studs, washers,dowel pin)
* Raw materials (lubricants, test-piece material,oils )
* First Aid kit
* Brooms and cleaning stuff
* Cotton waste
* Cleaning detergents
* Drawing papers
* Working drawings
* Operation sheets/ templates
* Reference materials

## PERFORM MACHINE/ EQUIPMENT MAINTENANCE

**UNIT CODE:** ENG/CU/MEM/CR/06/6/B

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Perform machine/equipment maintenance**

**Duration of Unit:** 165 hours

**Unit Description**

This unit describes the competencies required by a technician to perform machine/equipment maintenance. It involves competencies required to inspect machine/equipment, identify machine/equipment needs, plan and prepare for maintenance, conduct breakdown maintenance, conduct preventive maintenance, test, document maintenance work done where applicable on machine/equipment and perform housekeeping.

**Summary of Learning Outcomes**

1. Inspect machine/equipment
2. Identify machine/equipment maintenance needs
3. Prepare for machine/equipment maintenance
4. Conduct preventive maintenance
5. Conduct corrective maintenance
6. Test machine/equipment for functionality
7. Perform housekeeping

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Learning Outcome** | **Content** | | **Suggested**  **Assessment**  **Methods** | |
| **1.** Inspect machine/equipment | * Inspection safety * Inspection checklist * Machine/equipment specification * Inspection equipment * Inspection procedures * Acceptance criteria * Defects/variations * Inspection report | | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 2.Identify machine/ equipment maintenaince needs | * Work safety * Types of maintenance * Maintainance manuals * Machine/equipment faults * Spares Inventory management | | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| **3.** Prepare for machine/equipment maintenance | * Work safety * Maintenance history * Work plan   + Activity   + Materials   + Labour * Tools and equipment | | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 4.Conduct preventive maintenance | | * Maintenance safety * Switching off the machine * Signage and barricades * Notifications * Machine/equipment inspection * Maintainance manuals * Maintenance procedures * Cleaning * Lubrication * Re-painting * Maintenance reports * Handing over procedure | | * Administration of written and   oral test   * Administration of simulated tests * Observation |
| 5. Conduct corrective maintenance | | * Maintenance safety * Switching off the machine * Signage and barricades * Notifications * Machine/equipment inspection * Maintainance manuals * Maintenance procedures * Fault identification * Dismantling * Repair * Lubrication * Re-painting * Testing * Maintenance reports * Handing over procedure | | * Administration of written and   oral test   * Administration of simulated tests * Observation |
| 6.Test machine/equipment for functionality | | * Testing tools and equipment * Testing procedure * Calibration * Commission procedure * Maintenance reports | | * Administration of written and   oral test   * Administration of simulated tests * Observation |
| 7. Perform housekeeping tasks | | * 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) | | * Administration of written and   oral test   * Administration of simulated tests * Observation |

**Suggested Delivery Methods**

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

**Recommended Resources**

**Tools & Equipment**

* Measuring tools
* Marking out tools
* Hand tools
* Inspection tools and equipment
* Work benches
* Firefighting equipment
* Material handling equipment
* Tool box
* Machine tools

**Materials and supplies**

* PPEs – dust coat, safety boots, goggles
* Raw materials (lubricants, test-piece material,oils )
* Fasteners(draw bolts, rivets, nuts and bolts,screws,keys, studs, washers,dowel pin)
* First Aid kit
* Brooms and cleaning stuff
* Cotton waste
* Cleaning detergents
* Drawing papers
* Working drawings
* Operation sheets/ templates
* Reference materials

## MAINTAIN HYDRAULICS AND PNEUMATIC SYSTEMS

**UNIT CODE:** ENG/CU/MEM/CR/07/6/B

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Maintain hydraulics and pneumatic systems.**

**Duration of Unit:** 200 hours

**Unit Description**

This unit covers the competencies required to maintain hydraulic and pneumatic systems. Competencies include; to identify, inspect systems to be maintained, prepare maintenance components, performing testing of the maintained system, documenting system maintenance report and perform housekeeping.

**Summary of Learning Outcomes**

1. Identify system to be maintained
2. Inspect system to be maintained
3. Prepare components and materials for maintenance
4. Perform system maintenance
5. Test the maintained system
6. Perform housekeeping tasks

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** | |
| **1.** Identify system to be maintained | * Safety * Types of systems (hydraulics and pneumatics )   + Specification   + Functionality   + Circuitry   + Work environment | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 2. Inspect system to be maintained | * Work safety * Inspection procedure (checklist) * System specifications * Inspection tools and equipment * Classification of faults * Inspection records | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| **3.** Prepare component and materials for maintenance | * Work safety * Maintenance history * Work plan   + Activity   + Materials   + Labour * Tools and equipment | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 4.Perform system maintenance | * Maintenance safety   + Switching off the system   + Signage and barricades   + Notifications * System inspection * Maintainance manuals * Maintenance procedures   + Cleaning   + Lubrication   + Re-painting * Maintenance reports * Handing over procedure | | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 5 .Test the maintained system | * Testing tools and equipment * Testing procedure * Calibration * Training of operators * Commission procedure * Maintenance reports | | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 6. Perform housekeeping | * Cleaning of work environment (waste sorting and disposal) * Cleaning and storing of tools and equipment * Servicing and maintenance of systems (lubrication, inspection,   alignment and adjustment) | | * Administration of written and   oral test   * Administration of simulated tests * Observation | |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Discussions
* Practical work by trainee(s)
* Group work
* Industrial visits/Field visits
* YouTube for teaching/learning and inspiration
* Simulation

**Recommended Resources**

**Tools & Equipment**

* Measuring tools
* Marking out tools
* Hand tools
* Inspection tools and equipment
* Work benches
* Firefighting equipment
* Material handling equipment
* Tool box
* Machine tools

**Materials and supplies**

* PPEs – dust coat, safety boots, goggles
* Raw materials (lubricants, test-piece material,oils )
* Fasteners(draw bolts, rivets, nuts and bolts,screws,keys, studs, washers,dowel pin)
* First Aid kit
* Brooms and cleaning stuff
* Cotton waste
* Cleaning detergents
* Drawing papers
* Working drawings
* Operation sheets/ templates
* Reference materials

## MAINTAIN PUMPS AND AIR COMPRESSORS

**UNIT CODE:** ENG/CU/MEM/CR/08/6/B

**Relationship to Occupational Standards**

This unit addresses the unit of competency and meets the requirements specified by the Occupational Standards: **Maintain pumps and air compessors.**

**Duration of Unit:** 200 hours

**Unit Description**

This unit covers the competencies required to maintain pumps and air compressors. Competencies include; identify components to be maintained, inspect components, prepare for maintenance, perform maintenance and testing, document maintenance process and perform housekeeping.

**Summary of Learning Outcomes**

1. Identify components to be maintained
2. Inspect components to be maintained
3. Prepare components and materials for maintenance
4. Perform component maintenance
5. Test run the maintained pump/air compressor
6. Perform housekeeping tasks

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested**  **Assessment**  **Methods** | |
| **1.** Identify components to be maintained | * Safety * Types of air compressors(rotary, reciprocating, centrifugal and axial flow) * Types of pumps (rotary, reciprocating, centrifugal and axial flow) * Compressed air distribution system(types and components) * Types of components (valves, seals, nozzles, gauges, fan,vane,cylinders, pistons,hoses, casing and fittings)   + Specification   + Functionality   + Complexity   + Work environment | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 2. Inspect component to be maintained | * Work safety * Inspection procedure (checklist) * System specifications * Inspection tools and equipment * Classification of faults * Inspection records | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| **3.** Prepare component and materials for maintenance | * Work safety * Maintenance history * Work plan   + Activity   + Materials   + Labour * Tools and equipment | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 4.Perform component maintenance | * Maintenance safety   + Switching off the system   + Signage and barricades   + Notifications * System inspection * Maintainance manuals * Maintenance procedures   + Cleaning   + Lubrication   + Re-painting * Maintenance reports * Handing over procedure | | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 5 .Test run the maintained pump/air compressor | * Testing tools and equipment * Testing procedure * Calibration * Commission procedure * Maintenance reports | | * Administration of written and   oral test   * Administration of simulated tests * Observation | |
| 6.Perform housekeeping | * Cleaning of work environment (waste sorting and disposal) * Cleaning and storing of tools and equipment * Servicing and maintenance of systems (lubrication, inspection,   alignment and adjustment) | | * Administration of written and   oral test   * Administration of simulated tests * Observation | |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Discussions
* Practical work by trainee(s)
* Group work
* Industrial visits/Field work
* YouTube for teaching/learning and inspiration
* Simulation

**Recommended Resources**

**Tools & Equipment**

* Measuring tools
* Marking out tools
* Hand tools
* Inspection tools and equipment
* Work benches
* Firefighting equipment
* Material handling equipment
* Tool box
* Machine tools

**Materials and supplies**

* PPEs – dust coat, safety boots, goggles
* Raw materials (lubricants, test-piece material,oils )
* Fasteners(draw bolts, rivets, nuts and bolts,screws,keys, studs, washers,dowel pin)
* Spares (fittings, seals, rings, hoses)
* First Aid kit
* Brooms and cleaning stuff
* Cotton waste
* 33Cleaning detergents
* Drawing papers
* Working drawings
* Operation sheets/ templates
* Reference material.