

**REPUBLIC OF KENYA**

**COMPETENCY BASED CURRICULUM**

**FOR**

**PLANT AND SERVICE 3**



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 Kenya’s development blue print and sustainable development goals.

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted to the formulation of the Policy Framework for Reforming Education and Training. A key feature of this policy is the radical change in the design and delivery of the TVET training. This policy document requires that training in TVET be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that this Curriculum has been developed.

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

**PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING**

**MINISTRY OF EDUCATION**

**PREFACE**

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

The Technical and Vocational Education and Training Act No. 29 of 2013 on Reforming Education and Training in Kenya, emphasized the need toreform curriculum development, assessment and certification. This called for a shift to CBET to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labour force.

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

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

I am grateful to the Council Members, Council Secretariat, Mechanical engineering SSAC, expert workers and all those who participated in the development of this curriculum.

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

**ACKNOWLEDGEMENT**

This curriculum has been designed for competency-based training and has independent units of learning that allow the trainee flexibility in entry and exit. In developing the curriculum, significant involvement and support was received from various organizations.

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

I am convinced that this curriculum will go a long way in ensuring that workers in Mechanical Sector acquire competencies that will enable them to perform their work more efficiently.

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

**COUNCIL SECRETARY/CEO**

**TVET CDACC**

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**ACRONYMNS AND ABBREVIATIONS**

CDACC Curriculum Development, Assessment and Certification Council

EBK Engineers Board of Kenya

EBP Engineering best practice

EHS Environment, Health and Safety

IEE Institute of Electrical Engineers

IBMS Integrated Building Management System

KEBS Kenya Bureau of Standards

NCA National Construction Authority

OSHA Occupational Safety and Health Act

PPE Personal Protective Equipment

TVET Technical and Vocational Education and Training

SOP Standard operating procedure

WIBA Work injury benefits Act

ENG Engineering

OS Occupational Standards

CU Curriculum

PS Plant and Service

BC Basic Competencies

CC Common Competencies

CR Core Competencies

A Control version

**KEY TO UNIT CODE**

ENG/CU/PS/BC/01/3/A

Industry or sector

Curriculum

Occupational area

Type of competency

Competency number

Competency level

Control version

**OVERVIEW**

**Description of the course**

This course is designed to equip a mechanical plant and service individual with the competencies required to perform various duties in the mechanical sector as outlined in this curriculum.

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

**Basic Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/PS/BC/01/6/A | Communication skills | 15 | 1.5 |
| ENG/CU/PS/BC/02/6/A | Digital Literacy | 15 | 1.5 |
| ENG/CU/PS/BC/03/6/A | Entrepreneurial skills | 20 | 2 |
| ENG/CU/PS/BC/04/6/A | Employability skills | 20 | 2 |
| ENG/CU/PS/BC/05/6/A | Environmental literacy | 15 | 1.5 |
| ENG/CU/PS/BC/06/6/A | Occupational safety and health practices | 15 | 1.5 |
| **Total** | | **100** | **10** |

**Common Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/PS/CC/01/3/A | Mathematics | 30 | 3 |
| ENG/CU/PS/CC/02/3/A | Workshop process and material | 20 | 2 |
| ENG/CU/PS/CC/03/3/A | Mechanical science principle | 20 | 2 |
| ENG/CU/PS/CC/04/3/A | Material science and metallurgical process | 20 | 2 |
| ENG/CU/PS/CC/05/3/A | Electrical principles | 30 | 3 |
| ENG/CU/PS/CC/06/3/A | Technical Drawing | 20 | 2 |
| **Total** | | **140** | **14** |

**Core Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/PS/CC/01/3/A | General operation and maintenance of plant machinery | 50 | 5 |
| ENG/CU/PS/CC/02/3/A | Refrigeration and air conditioning systems maintenance | 40 | 4 |
| ENG/CU/PS/CC/03/3/A | Preform plant maintenance | 40 | 4 |
|  | Industrial Attachment | 200 | 20 |
| **Total** | | **330** | **33** |
| **Grand Total** | | **570** | **57** |

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

The total duration of the course is **570 hours** (19 weeks at 30 hours per week) inclusive of industrial attachment.

**Entry Requirements**

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

1. Kenya Certificate of Primary Education (K.C.P.E.)

**Or**

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

**Or**

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

**Industrial attachment**

An individual enrolled in this course will be required to undergo an industrial attachment in a Mechanical Engineering firm for a period of at least 200 hours. Attachment will be undertaken upon completion of the course or the unit of learning.

**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.

**Certification**

A candidate will be issued with a Certificate of Competency on demonstration of competence in a unit of competency. To attain the qualification Plant and Service Level 3, the candidate must demonstrate competence in all the units of competency as given in qualification pack. These certificates will be issued by TVET CDACC in conjunction with training provider.

**BASIC UNITS OF LEARNING**

**COMMUNICATION SKILLS**

**UNIT CODE:** ENG/CU/PS/BC/01/3/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate communication skills

**Duration of Unit:** 15 hours

**Unit Description**

This unit specifies the competencies required to demonstrate communication skills. It involves, obtaining and conveying workplace information, speaking English at a basic operational level, participating in workplace meetings and discussions and completing relevant work-related documents.

**Summary of Learning Outcomes**

1. Obtain and convey workplace information
2. Speak English at a basic operational level
3. Participate in workplace meetings and discussions
4. Complete relevant work-related documents

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Obtain and convey workplace information | * Communication process * Modes of communication * Medium of communication * Effective communication * Barriers to communication * Flow of communication * Sources of information * Types of questions * Organizational policies * Workplace etiquette * Ethical work practices in handling communication | * Written * Oral questioning * Observation |
| 1. Speak English at a basic operational level | * English grammar   + Nouns, verbs, adjectives, adverbs, pronouns prepositions * English speaking   + Pronunciation   + Simple conversations * Taking verbal instructions * Reading and writing in English * Forms of expression in English | * Written * Oral * Role play |
| 1. Participate in workplace meetings and discussions | * Nature of workplace meetings * Meeting protocols * Workplace interactions | * Oral questioning * Observation * Written tests |
| 1. Complete relevant work-related documents | * Types and purposes of workplace documents and forms * Methods used in filling forms and documents * Recording workplace data * Process of distributing workplace forms and documents * Report writing * Types of workplace reports | * Written tests * Oral questioning * Observation |

**Suggested Delivery Methods**

* Discussion
* Role play
* Brainstorming
* Viewing of related videos

**Recommended Resources**

* Desktop computers/laptops
* Projectors
* Report writing templates
* Pens
* Note books

**DIGITAL LITERACY**

**UNIT CODE:** ENG/CU/PS/BC/02/3/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate digital literacy

**Duration of Unit:** 20 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify computer hardware and software | * Definition of a computer * Functions of a computer * Components of a computer * Classification of computers * Computer software | * Written * Oral * Observation |
| 1. Apply security measures to data, hardware and software | * Data security and control * Security threats and control measures * Types of computer crimes * Detection and protection against computer crimes | * Written tests * Oral presentation * Observation |
| 1. Apply computer software in solving tasks | * Operating systems * Word processing * Spread sheets * Data base | * Oral questioning * Observation * Practical |
| 1. Apply internet and email in communication at workplace | * Computer networks * Uses of internet * Electronic mail (e-mail) concept | * Oral questioning * Observation * Oral presentation * Written report |

**Suggested Delivery Methods**

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

**Recommended Resources**

**Tools and equipment**

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

**ENTREPRENEURIAL SKILLS**

**UNIT CODE:** ENG/CU/PS/BC/03/3/A

**Relationship to occupational standards**

This unit addresses the unit of competency: Demonstrate entrepreneurial skills

**Duration of unit:** 20 hours

**Unit description**

This unit describes the competencies required to demonstrate entrepreneurial competencies. It includes, acquiring and developing entrepreneurial culture, identifying entrepreneurial opportunities, starting a small business, running and growing a small business.

**Summary of Learning Outcomes**

1. Acquire and develop entrepreneurial culture
2. Identify entrepreneurial opportunities
3. Start a small business
4. Run a small business
5. Grow a small business

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Acquire and develop entrepreneurial culture | * Definition of entrepreneur * Importance of entrepreneurship * Common terminologies in entrepreneurship * Entrepreneurship and employment creation * Formal and informal employment * Habits that promote entrepreneurial development * Cultural factors that inhibit entrepreneurship | * Observation * Individual/group assignments * Written * Oral |
| 1. Identify entrepreneurial opportunities | * Types, characteristics, qualities & role of entrepreneurs * SWOT analysis * Generating Business ideas * Business opportunities * Evaluation of business opportunities | * Observation * Individual/group assignments * Written * Oral |
| 1. Prepare a business plan | * Types of business plan * Components of a business plan * Importance of a business plan * Forms of business ownership * Importance of location of a small business * Resources required to start a small business | * Observation * Individual/group assignments * Written * Oral |
| 1. Start a small business | * Factors to consider when starting a small business * Legal requirement for starting a small business * Procedure of starting a small business * The dos and don’ts of starting a small business * Challenges faced when starting a small business and mitigating factors * Launch of a small business | * Oral * Observation * Individual/group assignments * Written |
| 1. Run a small business | * Organizational structure of a small business * Managing small business finances * Book keeping * Business support services * Marketing for small businesses * Basic IT application in small business | * Observation * Individual/group assignments * Written |
| 1. Grow a small business | * Methods of growing/expanding a small business * Resources for growing small business * Small business growth plan * ICT and business growth | * Observation * Individual/group assignments * Written |

**Suggested Delivery Methods**

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

**Recommended Resources**

* Case studies for small businesses
* Business plan template
* Laptop/ desktop computer
* Internet
* Telephone
* Writing materials

**EMPLOYABILITY SKILLS**

**UNIT CODE:** ENG/CU/PS/BC/04/3/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate employability skills

**Duration of Unit:** 20 hours

**Unit Description**

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

**Summary of Learning Outcomes**

1. Conduct self-management
2. Demonstrate critical safe work habits
3. Demonstrate workplace learning
4. Demonstrate workplace ethics

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Conduct self-management | * Self-awareness * Formulating personal vision, mission and goals * Strategies for overcoming life challenges * Emotional intelligence * Assertiveness * Developing and maintaining high self-esteem * Developing and maintaining positive self-image * Accountability and responsibility * Good work habits * Self-awareness * Financial literacy * Healthy lifestyle practices | * Observation * Written * Oral interview * Third party report |
| 1. Demonstrate critical safe work habits | * Stress and stress management * Punctuality and time consciousness * Interpersonal communication * Sharing information * Resources utilization * HIV and AIDS * Drug and substance abuse * Handling emerging issues | * Observation * Written * Oral interview * Third party report |
| 1. Demonstrate workplace learning | * Personal training needs identification and assessment * Cultural aspects of work * Application of learning * Safe use of technology * Identifying opportunities * Workplace innovation * Handling emerging issues * Future trends and concerns in learning | * Observation * Oral interview * Written * Third party report |
| 1. Demonstrate workplace ethics | * Meaning of ethics * Ethical perspectives * Values and beliefs * Organization code of ethics * Common ethical dilemmas * Organization culture * Corruption, bribery and conflict of interest * Privacy and data protection * Harassment and mutual respect * Financial responsibility/accountability * Etiquette * Emerging issues in ethics | * Observation * Oral interview * Written * Third party report |

**Suggested Methods of Delivery**

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

**Recommended Resources**

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

**ENVIRONMENTAL LITERACY**

**UNIT CODE**: ENG/CU/PS/BC/05/3/A

**Relationship to Occupational Standards**:

This unit addresses the unit of competency: Demonstrate environmental literacy

**Duration of Unit:** 15 hours

**Unit Description**

This unit describes the competencies required by a worker to control environmental hazard, control environmental pollution and comply with workplace sustainable resource use.

**Summary of Learning Outcomes**

1. Control environmental hazard
2. Control environmental Pollution
3. Demonstrate sustainable resource use

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Control environmental hazard | * Environmental Management and Coordination Act 1999 * Solid Waste Act * Storage of environmentally hazardous materials * Disposal of hazardous wastes * Types and uses of PPEs in line with environmental regulations * Occupational Safety and Health Act 2007 | * Written questions * Oral questions * Observation of work procedures |
| 1. Environmental Pollution Control | * Types of pollution * Environmental pollution control and management * Procedures for waste management | * Written questions * Oral questions * Observation of work procedures |
| 1. Demonstrate sustainable resource use | * Types of resources * Sustainable resource use and management * Principles of 3Rs (Reduce, Reuse, Recycle) | * Written questions * Oral questions * Observation of work procedures |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Discussion
* Demonstration by trainer
* Practice by trainee
* Observations and comments and corrections by trainers

**Recommended Resources**

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

**OCCUPATIONAL SAFETY AND HEALTH PRACTICES**

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

**Relationship to Occupational Standards**

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

**Duration of Unit:** 15 hours

**Unit Description**

This unit describes the competencies required by a worker in an industry to practice and promote safety and health at work.

**Summary of Learning Outcomes**

1. Prepare to apply workplace safety and health practices
2. Compliance with occupational safety and health Act

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Prepare to apply workplace safety and health practices | * Awareness of legislation that outlines the minimum standards for occupational safety and health requirements/ regulations * Benefits of implementing an occupational safety and health program * Safety requirements/ regulations of own work and of other workers * Workplace standards and procedures for incidents and emergencies * Prevention and Control Measures for accidents, injuries and sickness | * Oral questions * Written questions * Observation of work procedures |
| 2. Compliance with occupational safety and health Act | * Safety instructions and safety signs * Safe handling of tools, equipment and materials * Use of safe guards and safety devices * Reporting of hazards, incidents, injuries and sickness in the workplace | * Written questions * Oral questions * Observation of work procedures |

**Suggested Delivery Methods**

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

**Recommended Resources**

* Occupational safety and health standards
* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Client/supplier instructions
* Organizational or external personnel
* Machine/equipment manufacturer’s specifications and instructions
* Quality standards

**COMMON UNITS OF LEARNING**

**MATHEMATICS**

**UNIT CODE:** ENG/CU/PS/CC/01/3/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply mathematics

**Duration of Unit:** 30hours

**Unit Description**

This unit describes the competencies required by a worker in order to apply a wide range of mathematical calculations for work; apply ratios and proportions to solve problems; perform geometrical calculations; apply concepts of probability for work; perform commercial calculations and collect, organize and analyze statistical data.

**Summary of Learning Outcomes**

1. Apply a wide range of mathematical calculations for work
2. Apply ratios and proportions to solve problems
3. Perform geometrical calculations
4. Apply concepts of probability for work
5. Perform commercial calculations
6. Collect and present data
7. Apply measures of central tendency in work
8. Apply measures of dispersion in work
9. Apply sampling in work

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply a wide range of mathematical calculations for work | * Fundamentals of mathematics * Addition, subtraction, multiplication and division of positive and negative numbers * Algebraic expressions manipulation | * Written tests * Assignments * Supervised exercises * Written tests |
| 1. Apply ratios and proportions to solve problems | * Ratios and proportions * Meaning * Conversions into percentages * Direct and inverse proportions determination | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. Perform geometrical calculations | * Units of measurements and their symbols * Conversion of units of measurement * Perimeters of regular figures * Areas of regular figures * Volumes of regular figures | * Assignments * Supervised exercises * Written tests |
| 1. Apply concepts of probability for work | * + Meaning of probability   + Types of probability events * Dependent * Independent * Mutually exclusive   + Laws of probability   + Counting techniques * Permutation * Combination * Tree diagrams | * Written tests * Assignments * Supervised exercises |
| 1. Perform commercial calculations | * + Conversion of one currency to another   + Exchange rates calculation * Devaluation * Revaluation   + Product pricing   + Profit calculation   + Average sales determination   + Stock turnover   + Calculation of incomes   + Salaries * Gross * Net   + Wages * Time rate * Flat rate and overtime * Piece rate * Commission * Percentage * Bonus | * Oral * Written tests * Assignments * Supervised exercises |
| 1. Collect and present data | * + Classification of data * Grouped data * Ungrouped data   + Data collection * Observation * Recording   + Tabulation of data * Class intervals * Class boundaries * Frequency tables * Cumulative frequency   + Diagrammatic and graphical presentation of data e.g. * Histograms * Frequency polygons * Bar charts * Pie charts * Cumulative frequency curves | * Assignments * Supervised exercises * Written tests |
| 1. Apply measures of central tendency in work | * + Meaning of measures of central tendency   + Measures * Properties * Calculation and interpretation of mean, mode and median | * Written tests * Oral * Supervised exercises |
| 1. Apply measures of dispersion in work | * + Meaning of measures of dispersion   + Types, merits and demerits of absolute and relative measures   + Calculation and interpretation of measures of dispersion * Range * Mean deviation * Quartiles, deciles, percentiles and interquartile range * Variance and standard deviation | * Assignments * Supervised exercises * Written tests |
| 1. Apply sampling in work | * + Distinguishing between sampling and census   + Importance of sampling   + Errors in sampling   + Types of sampling and their limitations e.g. * Stratified random * Cluster * Judgmental | * Written tests * Oral * Reports |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

# WORKSHOP TECHNOLOGY PRACTICES

**UNIT CODE:** ENG/CU/PS/CC/07/3/A

**Relationship to Occupational Standards**:

This unit addresses the unit of competency: Apply workshop technology principles

Duration of Unit: 30 Hours

**Unit description**

This unit describes the competencies required by an automotive technician in order to apply a wide range of workshop technology skills in their work. It involves use of different methods to produce work pieces using basic tools while observing occupational safety and health legislations, regulations and safe working practices, interpret working drawings, select appropriate techniques for a given task to achieve specified results as well as perform housekeeping.

**Summary of Learning Outcome**

1. Interpreting working drawings
2. Choosing of appropriate tools and materials.
3. Marking out of the work pieces
4. Producing components as per the drawing
5. Performing finishing processes
6. Assembling produced parts
7. Performing housekeeping

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Interpreting working drawings | * Reading and extraction of information (dimensions, tolerances, BS/ANSI Drawing Standards, geometric ISO symbols & abbreviations) * Development of working procedure/ operational plan | * Administration of written and oral tests * Assessment of worksheet/ operation plans |
| 1. Choose appropriate tools and materials | * Types of hand tools * Using hand tools. * Using machine tools * Selection of tools as per the specific operation * Inspection and/or recalibration of tools * Demonstration of correct handling of tools. * Selection of material for the given component | * 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 |
| 1. Marking out of work piece(s) | * use of marking out tools * Laying out work piece(s) * Transfer of dimensions onto the work piece(s) | * Observation of laying out of work piece(s) * Assessment of transferred dimensions * Administration of oral and written questions |
| 1. Producing components as per the drawing | * Set up work piece on work holding device securely. * Perform suggested operations but not limited to: * Tapping * Drilling * boring * Filing * Grinding * Sawing * Turning * Soldering/brazing * welding * Finishing Activities * Polishing * Filing * Grinding * de-burring * painting of components * Joining and fitting | * Use of correct procedure * Assessment of the produced component |
| 1. Performing housekeeping | * Cleaning of work environment (waste sorting and disposal) * Cleaning and storing of tools and equipment * Servicing and maintenance of machine (lubrication, inspection, alignment and adjustment) | * Observation of servicing and maintenance of the machine * Observation of clean working environment * Observation clean and stored tools and equipment |
| 1. Maintain tools and equipment | * Meaning of terms * Workshop rules and practices * Machine maintenance activities * Maintenance of hand and machine tools and equipment e.g. * Cleaning * Oiling * Painting * Basic inspection * Storage |  |

**Suggested Delivery Methods**

* Demonstration by trainer
* Discussions
* Practical work by trainee(s)
* Exercises
* Industrials visits
* Internet.
* Simulation

**List of Recommended Resources**

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

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

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

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

# PRINCIPLES OF MECHANICAL SCIENCE

**UNIT CODE:** ENG/CU/PS/CC/03/3/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply principles of mechanical science

**Duration of Unit:** 20 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. Use the concept of mechanical science
2. Demonstrate understanding of friction
3. Determine parameters of a fluid system
4. Demonstrate knowledge of moments
5. Apply heat knowledge
6. Use of basic mechanical systems in power transfer

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Use the concept of mechanical science | * Define work, force, mechanical advantage and efficiency * Type of forces * Resolution of forces * Resultant force and equilibrium * Moments of a force * Newton’s laws of motion * Displacement, Velocity and acceleration * Work, Energy and Power | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. Demonstrate knowledge of moments | * Meaning of terms * Determination of moments * Principle of moments * Couples | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Demonstrate understanding of friction | * Meaning of terms * Laws of friction * Limiting friction * Coefficient of friction * Advantages and disadvantages of friction * Forces of friction | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Determine parameters of a fluid system | * Meaning of terms * Discussion of Pascal’s principles * Measuring fluid parameters * Gas laws * Fluid properties * Description and determination of fluid parameters | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Apply heat knowledge | * Meaning of terms * Working principles of heat * Temperature and its measurements * Heat capacity calculations | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Use of basic mechanical systems in power transfer | * + Meaning of terms and simple machines   + Uses and working principle of Gear trains   + Uses and working principles of Pulley system, hoists and lifts   + Uses and working principles of screws | * Assignments * Supervised exercises * Written tests * Practical test |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

# MATERIAL SCIENCE AND METALLURGICAL PROCESSES

**UNIT CODE:** ENG/CU/PS/CC/05/3/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply material science and perform metallurgical processes

**Duration of Unit:** 20 hours

**Unit Description:**

This unit covers unit of competency:Apply material science and metallurgical processes. Competencies include: analysing properties of engineering materials, performing ore extraction processes, producing materials and performing heat treatment, Prevent material corrosion.

**Summary of Learning Outcomes**

1. Analyse properties of engineering materials
2. Perform ore extraction processes
3. Produce materials
4. Perform heat treatment
5. Prevent material corrosion

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * 1. Analyse properties of engineering materials | * + Engineering materials are identified as per the procedures   + Physical properties of engineering material   + Mechanical properties of engineering materials * Crystal structure of materials | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 1. Perform ore extraction processes | * Safety measures in metal extraction * Method of metal extraction * Procedure in metal extraction processes * Storing of metal Extraction by- products * Disposing extraction by- products | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 1. Produce materials | * Meaning of terms * Types of materials e.g. * Iron * Non-ferrous * Alloys * Ceramics * Composite * Methods of material production and testing * Finishing and Refinement processes of various types of materials | * Assignments * Oral questioning * Supervised exercises * Written tests |
| 1. Perform heat treatment | * + Safety practices procedures   + Heat treatment processes   + Procedure in heat treatment processes   + Operations of heat treatment of metals | * Assignments * Supervised exercises * Written tests * Practical test |
| 1. Corrosion and its prevention | * Safety observation during corrosion prevention * Agents of corrosion * Causes of corrosion * Methods of corrosion prevention Corrosion prevention | * Assignments * Supervised exercises * Written tests * Practical test |

**Suggested Delivery Methods**

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

**List of Recommended Resources**

**Recommended Resources**

Tools and equipment

* Measuring tools and gauges
* Marking out tools
* Inspection tools and equipment
* Dressing tools
* Firefighting equipment

**Materials and supplies**

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

# ELECTRICAL PRINCIPLES

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply Electrical principles

**Duration of Unit:** 30 hours

**Unit Description**

This unit describes the competencies required by an artisan to apply Electrical principles: Competencies include: using the concept of basic electrical quantities, using the concept of DC and AC circuit in electrical installation, using basic electrical machines, using earthing in Electrical installations and applying 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 of basic electrical machine
4. Use of 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 | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * + 1. Use of basic electrical machine | * Types of Electrical machines * DC machines, * AC Single and three phase motors, generators and Transformers * Application of AC and DC machines | * Assignments * Oral questioning * Supervised exercises * Written tests * Practical tests |
| * + 1. Use of 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 strokes and their types   + Lightning protection components   + Testing a lightning system   + Application of lightning system   + Maintenance of lightning system | * Assignments * Oral questioning * Supervised exercises * Written tests |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

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

**TECHNICAL DRAWING**

**UNIT CODE:** ENG/CU/PS/CC/07/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit:** 20hours

**Unit Description**

This unit covers the competencies required to prepare and interpret technical drawings. It involves competencies to select, use and maintain drawing equipment and materials. It also involves producing plain geometry drawings, solid geometry drawings, pictorial and orthographic drawings of components and application of Computer Aided Design (CAD) packages.

**Summary of Learning Outcomes**

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

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

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

**Suggested Methods of Delivery**

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

**Recommended Resources**

* Drawing room
* Drawing instruments e.g. T-squares, set squares, drawing sets
* Drawing tables
* Pencils, papers, erasers
* Masking tapes
* Computers installed with relevant CAD packages

# CORE UNITS OF LEARNING

# GENERAL OPERATION AND MAINTENANCE OF PLANT MACHINERY

**UNIT CODE:** ENG/CU/PS/CR/01/3/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Operate and maintain plant machinery.

**Duration of Unit:** 50 hours

**Unit Description**

This unit covers the competencies required in general operation and maintenance of plant machinery. Competencies includes; operating, maintaining and test running of plant machinery

**Summary of Learning Outcomes**

* + 1. Operate plant machinery
    2. Maintain plant machinery

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| * Operate plant machinery | * Safety, checks and precautions in the operation of the plant machinery * Tools, equipment and materials for operation of the plant machinery. * Prepare plant machinery for operation * Conduct pre-operational checks * Power source. * Oil levels * Water levels * Operation procedures of plant machinery   + Starting procedure   + Setting out operating parameters   + Operational checks   + Stopping procedures * Post-operational checks * Oil levels * Water levels | * Observation * Oral questioning * Written tests * Practical tests |
| * Maintain plant machinery | * Safety measures in machine maintenance * conduct **CUT OUT/ LOCK OUT** of plant machinery * Prepare tools, equipment and materials for maintenance in plant machinery. * Prepare plant machinery for maintenance as per workplace procedures * Maintain plant machinery as per workplace maintenance procedures | * Observation * Oral questioning * Written tests * Practical tests |
| 3. Test run of plant machinery | * Safety measures, rules and regulations on test running to be adhered to. * Preparation for test running as per laid out procedures. * Tools and equipment for test running to be assembled and used correctly. * Test running to be carried out as per laid out procedures | * Observation * Oral questioning * Written tests * Practical tests |

**Suggested Methods of Delivery**

* Discussions
* Site visits
* On-job-training
* Charts and Audio-visual presentations

**Recommended Resources**

* Computers
* Printers
* Cameras
* Stationery

# REFRIGERATION AND AIR CONDITIONING SYSTEMS MAINTAINANCE

**UNIT CODE:** ENG/CU/PS/CR/02/3/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: maintain refrigeration and air conditioning system

**Duration of Unit:** 40 hours

**Unit Description**

This unit covers the competencies required to install refrigeration and air conditioning system. Competencies includes; assembling of tools, equipment and materials, conducting basic electrical wiring, servicing and test running of refrigeration and air conditioning systems.

**Summary of Learning Outcomes**

1. Assemble refrigeration and air conditioning tools, equipment and materials
2. Conduct basic electrical wiring for refrigeration and air conditioning systems
3. Service refrigeration and air conditioning systems
4. Test Run serviced refrigeration and air conditioning

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Assemble refrigeration and air conditioning tools, equipment and materials | * Tools, equipment and materials in refrigeration installation e.g. * Gauge manifold * Flaring tools * Swaging tools * Pipe cutters * Pipe bending tools * Refrigerants * Refrigerant cylinder * Ducts material * Tools configuration * Material assembling techniques * Safety in tools equipment and material handling. | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Conduct basic electrical wiring for refrigeration and air conditioning systems | * Safety measures, rules and regulations in basic electrical wiring. * Tools, equipment and materials in basic electrical wiring. * Basic wiring systems in refrigeration and air conditioning | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Service refrigeration and air conditioning systems | * Safety measures and precautions during service of refrigeration and air conditioning * Service procedures for refrigeration and air conditioning * Various types of checks carried out after servicing of refrigeration and air conditioning systems | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Test Run serviced refrigeration and air conditioning | * Safety measures, rules and regulations for test running are adhered to workplace procedures * Assemble and use Tools and equipment for test running correctly * Test run serviced refrigeration and air conditioning systems. * Adjust various refrigeration and air conditioning systems after test run. | * Observation * Oral questioning * Written tests * Practical tests |

**Suggested Methods of Delivery**

* Demonstration by trainer
* Practice by the trainee
* Field trips
* Discussions

**Recommended Resources**

* Stationery
* Computers
* Projectors
* Printers
* Manuals
* Relevant catalogues

# PEPLANT MAINTENANCE

**UNIT CODE:** ENG/OS/PS/CR/03/3/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform plant maintenance

**Duration of Unit:** 40 hours

**Unit Description**

This unit covers the competencies required to perform plant maintenance. Competencies includes: assembling of maintenance tools, equipment and materials, decommissioning of plant equipment to be maintained, carrying out maintenance and test running

**Summary of Learning Outcomes**

1. Assemble maintenance tools, equipment and materials
2. Decommission plant equipment to be maintained
3. Carry out maintenance
4. Test run

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Assemble maintenance tools, equipment and materials | * Safety measures in handling of tools, equipment and materials * Set tools and equipment for plant maintenance. * Assemble maintenance tools, equipment and materials | * Observation * Written tests * Oral questioning |
| 1. Decommission plant equipment to be maintained | * Safety rules in plant decommissioning * Plant decommissioning procedures | * Oral questioning * Written tests * Practical test |
| 1. Carry out maintenance | * Use checklist in plant maintenance * Safety in plant maintenance * Basic fault diagnosis procedures * Maintenance activities e.g * Cleaning * Oiling * Greasing * Service and repair * Plant Maintenance waste disposal | * Observation * Oral questioning * Written tests |
| 1. Test Run | * Safety measures, rules and regulations are adhered to in test running. * Test run the plant. * Adjust the maintained plant. | * Oral questioning * Written tests * Practical test |

**Suggested Methods of Delivery**

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

**Recommended Resources**

* Computer
* Stationery
* Projectors
* Manuals