

**REPUBLIC OF KENYA**

**COMPETENCY BASED CURRICULUM**

**FOR**

**PLANT AND SERVICE ENGINEERING LEVEL 5**



TVET CDACC

P.O BOX 15745-00100

NAIROBI

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# FOREWORD

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

TABLE OF CONTENTS

[FOREWORD i](#_Toc8305806)

[PREFACE ii](#_Toc8305807)

[ACKNOWLEDGEMENT iii](#_Toc8305808)

[ACRONYMNS AND ABBREVIATIONS v](#_Toc8305809)

[KEY TO UNIT CODE vi](#_Toc8305810)

[OVERVIEW vii](#_Toc8305811)

[BASIC UNITS OF LEARNING 1](#_Toc8305812)

[COMMUNICATION SKILLS 2](#_Toc8305813)

[DIGITAL LITERACY 5](#_Toc8305814)

[ENTREPRENEURIAL SKILLS 8](#_Toc8305815)

[EMPLOYABILITY SKILLS 11](#_Toc8305816)

[ENVIRONMENTAL LITERACY 15](#_Toc8305817)

[OCCUPATIONAL SAFETY AND HEALTH PRACTICES 19](#_Toc8305818)

[COMMON COMPETENCY 21](#_Toc8305819)

[ENGINEERING MATHEMATICS 22](#_Toc8305820)

[PRINCIPLES OF MECHANICAL SCIENCE 30](#_Toc8305821)

[FLUID MECHANICS 33](#_Toc8305822)

[THERMODYNAMICS 35](#_Toc8305823)

[MATERIAL SCIENCE AND METALLURGICAL PROCESSES 38](#_Toc8305824)

[ELECTRICAL PRINCIPLES 42](#_Toc8305825)

[WORKSHOP TECHNOLOGY PRACTICES 46](#_Toc8305826)

[CORE UNITS OF LEARNING 51](#_Toc8305827)

[INSTALLATION OF MECHANICAL PUMPS AND COMPRESSORS 52](#_Toc8305828)

[OPERATION AND MAINTENANCE OF PLANT MACHINERY 58](#_Toc8305829)

[REFRIGERATION AND AIR CONDITIONING SYSTEMS 60](#_Toc8305830)

[MECHANICAL PROJECT MANAGEMENT 62](#_Toc8305831)

[PLANT MAINTENANCE 66](#_Toc8305832)

ACRONYMNS AND ABBREVIATIONS

OWAS Open web application security

NIST National institute of Standards and Technology

KEBS Kenya Bureau of Standards

NCA National Construction Authority

OSHA Occupational Safety and Health Act

WIBA Work injury benefits Act

EHS Environment, Health and Safety

CDACC Curriculum Development, Assessment and Certification Council

IBMS Integrated Building Management System

PPE Personal Protective Equipment

TVET Technical and Vocational Education and Training

ENG Engineering

OS Occupational Standards

CU Curriculum

PS Plant and Service

BC Basic Competencies

# KEY TO UNIT CODE

**ENG/CU/PS/BC/01/5/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 operator with the competencies required to perform various duties as outlined in the curriculum in the mechanical sector.

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

**Basic Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/PS/BC/01/6/A | Communication skills | 25 | 2.5 |
| ENG/CU/PS/BC/02/6/A | Digital Literacy | 45 | 4.5 |
| ENG/CU/PS/BC/03/6/A | Entrepreneurial skills | 70 | 7 |
| ENG/CU/PS/BC/04/6/A | Employability skills | 50 | 5 |
| ENG/CU/PS/BC/05/6/A | Environmental literacy | 25 | 2.5 |
| ENG/CU/PS/BC/06/6/A | Occupational safety and health practices | 25 | 2.5 |
| **Total** | | **240** | **24** |

**Common Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/PS/CC/01/6/A | Engineering mathematics | 60 | 6 |
| ENG/CU/PS/CC/02/6/A | Workshop process and material | 60 | 6 |
| ENG/CU/PS/CC/03/6/A | Mechanical science principle | 60 | 6 |
| ENG/CU/PS/CC/04/6/A | Fluid mechanics | 60 | 6 |
| ENG/CU/PS/CC/05/6/A | Material science and metallurgical process | 60 | 6 |
| ENG/CU/PS/CC/06/6/A | Electrical principles | 60 | 6 |
| ENG/CU/PS/CC/07/6/A | Technical Drawing | 60 | 6 |
| **Total** | | **420** | **42** |

**Core Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/PS/CC/01/6/A | Installation of mechanical pumps | 120 | 12 |
| ENG/CU/PS/CC/02/6/A | Hydraulic and pneumatic systems | 130 | 13 |
| ENG/CU/PS/CC/03/6/A | Operation and maintenance of plant machinery | 120 | 12 |
| ENG/CU/PS/CC/04/6/A | Refrigeration and air conditioning system | 130 | 13 |
|  | Industrial Attachment | 360 | 36 |
| **Total** | | **860** | **86** |
| **Grand Total** | | **1,520** | **152** |

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

The total duration of the **course is 1,520 hours** (50 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 Secondary Education (K.C.S.E.) with a minimum mean grade of D (D Plain)

**Or**

1. Level 4 certificate in Plant and service engineering or related course with **one** year of continuous work experience

**Or**

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

**Industrial attachment**

An individual enrolled in this course will be required to undergo an industrial attachment in a Mechanical Engineering firm for a period of at least 360 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 Engineering Operator Level 5, 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/01/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate communication skills

**Duration of Unit:** 25hours

**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. Utilize specialized communication skills processes
2. Contribute to the development of communication strategies
3. Conduct interviews
4. Facilitate group discussions
5. Represent the organization

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

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

**Suggested Delivery Methods**

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

**Recommended Resources**

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

## DIGITAL LITERACY

**UNIT CODE:** ENG/CU/PS/BC/02/5/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate digital literacy

**Duration of Unit:** 45 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

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

**Suggested Delivery Methods**

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

**Recommended Resources**

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

## ENTREPRENEURIAL SKILLS

**UNIT CODE:** ENG/CU/PS/BC/03/5/A

**Relationship to occupational standards**

This unit addresses the unit of competency: Demonstrate entrepreneurial skills

**Duration of unit:** 70 hours

**Unit description**

This unit describes the competencies critical to demonstration of entrepreneurial capabilities. It involves, enhancing the entrepreneur’s business skills, fostering a culture of continuous improvement at individual and organization level, implementing appropriate internal controls for profitability, improving employed capital base and undertaking regional/county business expansion.

**Summary of Learning Outcomes**

1. Develop one’s business skill
2. Develop individual workers and teams
3. Expand markets and customers
4. Expand employed capital
5. Undertake regional/county business expansion

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Develop one’s business skill | * 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. Develop individual workers and teams | * Good staff/workers * 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. Expand markets and customers base | * Maintaining appropriate cash flow in the organization * Internal controls * Business break-even point * Business profitability determinants * Prudent purchases in an enterprise * Reducing business expenses * Good staff/workers and customer relations * Identifying and maintain new customers and markets * Product/ service promotions * Products / services diversification * SWOT / PESTEL analysis * Conducting a business survey * Market expansion * Small business records management * Book keeping and auditing for small businesses * Business support services * Small business resources mobilization and utilization * Basic business social responsibility * Management of small business * Word processing concepts in small business management * Computer application software * Monitoring and controlling business operations | * Oral * Observation * Case studies * Individual/group assignments * projects * Written |
| 1. Expand employed capital | * Employed capital in small businesses * Share holdings * Business expansion and diversification * Resources for growing small business * Small business Strategic Plan * Cooperate Social responsibility * Computer software in business development * ICT and business growth | * Observation * Case studies * Individual/group assignments * projects * Written |
| 1. Undertake county/regional business expansion | * Region identification process * Regional laws and regulation * Business regional expansion requirements | * Oral * Observation * Case studies * Individual/group assignments * projects * Written |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

## EMPLOYABILITY SKILLS

**UNIT CODE:** ENG/CU/PO/BC/04/5/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate employability skills

**Duration of Unit:**  50 hours

**Unit Description**

This unit covers competencies required to demonstrate employability skills. It involves competencies for exuding self-awareness and ability to deal with everyday life challenges; demonstrating critical safe work habits and leading a workplace team; planning and organizing work activities; applying learning, creativity and innovativeness in workplace functions; pursuing professional growth and managing time effectively in the workplace.

**Summary of Learning Outcomes**

1. Develop self-awareness and ability to deal with life challenges
2. Demonstrate critical safe work habits for employees
3. Lead a workplace team
4. Plan and organize work
5. Maintain professional growth and development in the workplace.
6. Demonstrate learning, creativity and innovativeness in the workplace.

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Develop self-awareness and ability to deal with life challenges | * Self-awareness * Formulating personal vision, mission and goals * Strategies for overcoming life challenges * Managing emotions * Emotional intelligence * Asserting one-self * Assertiveness versus aggressiveness * Expressing personal thoughts, feelings and beliefs * Self esteem * Developing and maintaining high self-esteem * Developing and maintaining positive self-image * Sharing personal feelings * Setting performance targets * Monitoring and evaluating performance * Articulating ideas and aspirations * Accountability and responsibility | * Observation * Written * Oral interview * Third party report |
| 1. Demonstrate critical safe work habits for employees | * Stress and stress management * Time concept * Punctuality and time consciousness * Leisure * Integratingpersonal objectives into organizational objectives * Resources mobilization * Resources utilization * Setting work priorities * Developing healthy relationships * HIV and AIDS * Drug and substance abuse * Dealing with emerging issues | * Observation * Written * Oral interview * Third party report |
| 1. Lead a workplace team | * Leadership * Influence * Team building * Determination of team roles and objectives * Team parameters and relationships * Individual responsibilities in a team * Forms of communication * Business communication * Complementing team activities * Gender and gender mainstreaming * Human rights protocols * Developing healthy relationships * Maintaining relationships * Conflicts and conflict resolution | * Observation * Oral interview * Written * Third party report |
| 1. Plan and organize work | * Planning * Organizing * Schedules of activities * Developing work plans * Developing work goals/objectives and deliverables * Monitoring work activities * Evaluating work activities * Resource mobilization * Resource allocation * Resource utilization * Decision making * Problem solving * Negotiation | * Observation * Oral interview * Written * Third party report |
| 1. Maintain professional growth and development in the workplace | * Avenues for professional growth * Training and career opportunities * Assessing training needs * Mobilizing training resources * Licenses and certifications for professional growth and development * Pursuing personal and organizational goals * Managing work priorities and commitments * Recognizing career advancement | * Observation * Oral interview * Written * Third party report |
| 1. Demonstrate learning, creativity and innovativeness in the workplace | * Managing own learning * Mentoring * Coaching * Networking * Variety of learning context * Application of learning * Safe use of technology * Taking initiative/proactive * Flexibility * Identifying opportunities * Generating new ideas * Workplace innovation * Performance improvement | * 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/05/5**/**A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate environmental literacy

**Duration of Unit:** 25 hours

**Unit Description**

This unit describes the competencies required to 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. Control environmental Pollution
3. Demonstrate sustainable resource use
4. Evaluate current practices in relation to resource usage
5. Identify Environmental legislations/conventions for environmental concerns
6. Implement specific environmental programs
7. Monitor activities on Environmental protection/Programs

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

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

**Suggested Delivery Methods**

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

**Recommended Resources**

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

## OCCUPATIONAL SAFETY AND HEALTH PRACTICES

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

**Relationship to Occupational Standards**

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

**Duration of Unit:** 25 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify workplace hazards and risks | * Identification of hazards in the workplace and/or the indicators of their presence * Evaluation and/or work environment measurements of OSH hazards/risk existing in the workplace is conducted by * Authorized personnel or agency * Gathering of OHS issues and/or concerns raised | * Oral questions * Written tests * Observation of trainees identify hazards and risks |
| 1. Identify and implement appropriate control measure to hazards and risks | * Prevention and control measures, 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 of implementation of control measures |
| 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 tests * Practical test * Observation |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

# COMMON UNITS LEARNING

## ENGINEERING MATHEMATICS

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply Engineering mathematics

**Duration of Unit:** 60 hours

**Unit Description**

This unit describes the competencies required by a plant and service Engineering operator to apply a wide range of engineering mathematics in their work. This includes applying algebraic functions, trigonometry and hyperbolic functions, complex numbers, coordinate geometry, carrying out binomial expansion, calculus, Statistics, Vector theory, Matrix, Numerical methods, probability, commercial calculations, estimations, measurements and calculations of quantities in solving problems.

**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. Apply Statistics
8. Apply Vector theory
9. Apply Matrix
10. Apply Numerical methods
11. Apply concept of probability for work
12. Perform commercial calculations
13. Perform Estimations, Measurements and calculations of quantities

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

|  |  |  |
| --- | --- | --- |
| **Electrical Curriculum** | | |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * 1. Apply Algebra | * Base and Index * Law of indices * Indicial equations * Laws of logarithm * Logarithmic equations * Conversion of bases * Use of calculator * Reduction of equations * Solution of equations reduced to quadratic form * Solutions of simultaneous linear equations in three unknowns * Solutions of problems involving AP and GP | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 1. Apply Trigonometry and hyperbolic functions | * Half -angle formula * Trigonometric functions * Parametric equations * Relative and absolute measures * Measures calculation * Meaning of hyperbolic equations * Properties of hyperbolic functions * Evaluations of hyperbolic functions Hyperbolic identities * Inverse hyperbolic functions | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 1. Apply complex numbers | * Meaning of complex numbers * Stating complex 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 complex numbers to engineering | * Assignments * Oral questioning * Supervised exercises * Written tests |
| * 1. 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 |
| * 1. 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 |
| * 1. Apply Calculus | * Meaning of derivatives of a function * Differentiation from fist principle * Tables of some common derivatives * Rules of differentiation * Rate of change and small change * Stationery points of functions of two variables * Meaning of integration * Indefinite and definite integral | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 1. Apply Statistics | * Classification of data   Grouped data  Ungrouped data   * Data collection * Tabulation of data   Class intervals  Class boundaries  Frequency tables   * Diagrammatic and graphical presentation of data e.g.   Histograms  Frequency polygons  Bar charts  Pie charts  Cumulative frequency curves   * Measures of central tendency mean, mode and median * Measures of dispersion   Variance and standard deviation | * Assignments * Oral questioning * Supervised exercises * Written tests * Simulation * Data modelling |
| * 1. Apply Vector theory | * Definition of dot and cross product of vectors * Solution of problems involving dot and cross production of cross * Definition of operators * Definition of vector field * Solutions of problems involving vector fields | * Assignments * Oral questioning * Supervised exercises * Written tests |
| * 1. Apply Matrix methods | * Matrix operation * Determinant of 2x2 matrix * Inverse of 2x2 matrix * Solutions of linear simultaneous equations in three unknowns * Application of matrices | * Assignments * Oral questioning * Supervised exercises * Written tests |
| * 1. Apply Numerical methods | * Meaning of interpolation and extrapolation * Application of interpolation * Application of interactive methods to solve equations * Application of interactive methods to areas and volumes | * Assignments * Oral questioning * Supervised exercises * Written tests |
| 1. Apply concepts of probability in work | * + Meaning of probability   + Types of probability events * Dependent * Independent * Mutually exclusive   + Laws of probability   + Counting techniques * Permutation * Combination * Tree diagrams * Venn diagrams | * Assignments * Oral questioning * Supervised exercises * Written tests |
| 1. Perform commercial calculations | * + Product pricing   + Average sales determination   + Stock turnover   + Calculation of incomes   + Profit and loss calculations   + Salaries * Gross * Net   + Wages * Time rate * Flat rate * Overtime * Piece rate * Commission * Percentage * Bonus   + Conversion of one currency to another   + Exchange rates calculation * Devaluation * Revaluation | * Oral questioning * Written tests * Assignments * Supervised exercises |
| 1. Perform estimations, measurements and calculations of quantities | * Units of measurements and their symbols * Conversion of units of measurement * Calculation of length, width, height, perimeter, area and angles of figures * Measuring tools and equipment * Performing measurements and estimations of quantities | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

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

## PRINCIPLES OF MECHANICAL SCIENCE

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

**Relationship to Occupational Standards**

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

**Duration of Unit:** 60 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. Determine effects of loading in static and dynamic engineering systems
3. Analyze properties of materials
4. Determine parameters of a fluid system
5. 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 * State and explain newton’s laws of motion * Calculation velocity, distance, and acceleration * Conversion and SI units of energy, power and work | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. Determine effects of loading in static and dynamic engineering systems | * Explain type of forces * Discussion and analysis of reaction of forces * Calculation of coefficient of friction and inclined plane * Resolve the forces * Calculate the resultant force and equilibrium * Discuss the application of different forces * Calculation of moments of a force, | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. Analyze properties of materials | * Definition of mechanical properties of materials * Draw the stress strain graph * Discuss application of material depending on their properties * Discuss effect of environmental factors on material properties. | * Assignments * Oral questioning * Supervised exercises * Written tests |
| 1. Determine parameters of a fluid system | * Discussion of Pascal’s principles * Measuring fluid parameters * State the laws of gases * Discuss properties of water and steam | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Use of basic mechanical systems in power transfer | * + 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

## FLUID MECHANICS

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply fluid mechanics principles

**Duration of Unit:** 60 hours

**UNIT DESCRIPTION**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Understand flow of fluids | * + Flow rate in pipes is   + Losses in pipes are determined   + Causes of losses in pipes * Flow losses equations | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. 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 |
| 1. 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 |
| 1. Operate fluid pumps | * + Principle of operation of pumps and compressors   + 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
* Online video clips
* Power point presentation
* Exercises by trainee

**Recommended Resources**

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

## MATERIAL SCIENCE AND METALLURGICAL PROCESSES

**UNIT CODE:** ENG/CU/PS/CC/05/5/A

**Relationship to Occupational Standards**

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

**Duration of Unit:** 60 hours

**Unit Description:**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * 1. Analyse properties of engineering materials | * + Engineering materials is identified as per the procedures   + Physical properties of engineering material   + Mechanical properties of engineering materials * Crystal structure of materials | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 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 iron materials | * Ore smelting processes. * Composition of iron * Method of producing iron material * Refinement processes | * Assignments * Oral questioning * Supervised exercises * Written tests |
| * 1. Produce alloy materials | * + Tools and equipment for alloy production   + Alloy formation process * Testing alloy products quality | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| * 1. Produce non-ferrous materials | * + Extraction of Non-ferrous materials   + Smelting and purifying of extracted non-ferrous material   + Testing Non-ferrous material   + Identifying Alloying elements for non-ferrous materials   + Alloy formation process   + Testing of Alloys for non-ferrous material | * Assignments * Supervised exercises * Written tests * Practical test |
| * 1. Produce ceramics materials | * + Composition of ceramic materials   + Manufacturing process for ceramics   + Production of Ceramic materials   + Finishing processes for ceramic materials | * Assignments * Supervised exercises * Written tests * Practical test |
| 1. Produce composite materials | * + Types of composites   + Elements involve in composite formation   + Formation process of composites   + Testing of composite materials | * Assignments * Supervised exercises * Written tests * Practical test |
| 1. Utilise other engineering materials | * + Identifying and selecting engineering materials   + Developing operation plan   + Setting up production machine   + Setting production parameters   + Production process for engineering materials | * Assignments * Supervised exercises * Written tests * Practical test |
| 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. 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 |
| 1. Corrosion and its prevention | * 1. Safety observation during corrosion prevention   2. Corrosion type is identified   3. Causes of corrosion   4. Methods of corrosion prevention   5. 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:** 60 hours

**Unit Description**

This unit describes the competencies required by an operator to apply a wide range of Electrical principles in their work. Which includes; Use of the concept of basic Electrical quantities, use of the concepts of D.C and A.C circuits in electrical installation, use of basic electrical machine, use of earthing in Electrical installations, apply lightning protection measures and Demonstrating the understanding of Refrigeration and Air conditioning

**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
6. Demonstrate understanding of Refrigeration and Air conditioning

**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 | * 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 lightening protection measures | * + Meaning of lightening   + Lightening strokes and their types   + Lightening protection components   + Testing a lightening system   + Application of lightening system   + Maintenance of lightening system | * Assignments * Oral questioning * Supervised exercises * Written tests |
| * + 1. Demonstrate understanding of Refrigeration and Air conditioning | * Meaning of Refrigeration and Air Conditioning * Operation of Refrigeration and Air conditioning * Plant layout of Refrigeration and Air conditioning 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

## WORKSHOP TECHNOLOGY PRACTICES

**UNIT CODE:** ENG/CU/PS/CC/07/5/A

**Relationship to Occupational Standards**:

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

Duration of Unit: 240 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 | * Use of correct procedure * Assessment of the produced component |
| 1. Performing finishing processes | * Finishing * Polishing * Filing * Grinding * de-burring * painting of components | * Observation of degree of surface finish * Assessment of finished surface(s) using inspection tools * Assessment of finished surface(s) visually |
| 1. Assembling produced parts | * Joining and 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 |
| 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 |

**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

# CORE UNITS OF LEARNING

## INSTALLATION OF MECHANICAL PUMPS AND COMPRESSORS

**UNIT CODE:** ENG/OS/PS/CR/01/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Install mechanical pumps and compressors

**Duration of Unit:** 120 hours

**Unit Description**

This unit covers the competencies required to install mechanical pumps and compressor. Competencies include; Interpreting installation design layout, preparing installation layout, installing identified pumps and compressors, test running installed pumps and compressors and preparing and documenting pump and compressors installation reports.

**Summary of Learning Outcomes**

1. Interpret installation design layout
2. Prepare installation layout
3. Install identified pump and compressors
4. Install prime movers
5. Test run installed pump and compressors
6. Prepare and document pump and compressors installation report

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Interpret installation design layout | * Meaning of terms * Scales used in pumps and compressors layout design * Types of pumps and their design layout * Types of compressors and their installation layout design * Pumps and compressors layout design interpretation. * Factors to consider in interpretation of pumps and compressors installation layout e.g. * Measurements and dimensions * Materials and tools * Ground levels * Mounting bolts | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Prepare installation layout | * Meaning of terms * Tools and equipment used in preparation of installation layout * Various national and international standards in preparation of pump installation layout | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Install identified pump and compressors | * Meaning of terms * Tools and equipment used in pump and compressors installation * Types of fasteners and fitting in pump installation * Pump installations alignment * Fluid flow in pump installation | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Install prime movers | * Meaning of terms * Types of prime movers and their operation * Tools, equipment and materials in used in installation of prime movers * Standards and procedures in installation of prime movers * Prime movers installation alignment * Standards in fastening of the prime movers | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Test run installed pump and compressors. | * Meaning of terms * Various types of checks carried out after pump and compressor installation * Various pump and compressors installation adjustments * Basic pump and compressor installation maintenance | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Prepare and document pump and compressors installation report | * Preparation of installation report * Report dissemination * Report filing | * Observation * Oral questioning * Practical tests * Written tests |

**Suggested Methods of Delivery**

* Demonstration by trainer
* Practice by the trainee
* Field trips
* On-job-training
* Discussions

**Recommended Resources**

* Stationery
* National and International standards
* Projectors
* Computers
* Manuals
* Printers
* Internet
* Alignment equipment
* Occupational Safety and Health Act (OSHA)
* National Environmental Management Authority (NEMA) regulations
* National Construction Authority (NCA) regulations
* Other relevant resources

**HYDRAULIC AND PNEUMATIC SYSTEMS**

**UNIT CODE:** SEC/CU/CS/CR/03/5

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Install hydraulic and pneumatic systems

**Duration of Unit:** 130 hours

**Unit Description**

This unit covers the competencies required to install hydraulic and pneumatic systems. Competencies include; identifying system to be installed, interpreting system design installation layout, preparing installation components, installing identified system, performing testing of the installed system and preparing and documenting system installation report.

**Summary of Learning Outcomes**

1. Identify system to be installed
2. Interpret system design installation layout
3. Prepare installation components
4. Install identified system
5. Perform testing of the installed system
6. Prepare and document system installation report

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| * + - 1. Identify system to be installed | * Meaning of terms * Types of systems * Hydraulic systems * Pneumatic systems * Hydro-pneumatic * Factors to consider in selecting systems | * Written tests * Oral questioning * Practical tests * Observation |
| 1. Interpret system design installation layout | * Meaning of terms * Factors to be considered in the interpretation of the systems installation design layout * Measurement * Scale * Materials and tools * System orientation * Ground level | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Prepare installation components | * Meaning of Terms * Components of Hydraulic & Pneumatic system. * Safety factors on component handling. | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Install identified system | * Meaning of teams * Safety in installation of the system * Installation procedures * Inspection of installed system | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Perform testing of the installed system | * Meaning of terms * Types of tests e.g * Pressure * Leakage * Flow rate * Temperature * Noise level * Standards in system testing * Parameters adjustment | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Prepare and document system installation report | * Report preparation * Report dissemination * Report filing | * Observation * Oral questioning * Practical tests * Written tests |

**Suggested Methods of Delivery**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Field trips
* On-job training
* Discussions

**Recommended Resources**

* Stationery
* Computers
* Projectors
* National and international standards
* Manuals
* Printers
* Any other relevant resources
* Occupational safety and health act (OSHA)
* Work injury benefits act(WIBA)
* Manufacturers’ catalogues
* KEBS standards

## OPERATION AND MAINTENANCE OF PLANT MACHINERY

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

**Relationship to Occupational Standards**

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

**Duration of Unit:** 120 hours

**Unit Description**

This unit covers the competencies required in to operate and maintain plant machinery. Competencies includes; classifying plant machinery, identifying task and machine to be operated, operating identified plant machinery, maintaining and testing plant machinery and prepare and document plant operation and maintenance reports.

**Summary of Learning Outcomes**

* + 1. Classify plant machinery
    2. Identify task and machine to be operated
    3. Operate identified plant machinery
    4. Maintain and test plant machinery
    5. Prepare and document plant operation and maintenance reports

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Classify plant machinery | * Meaning of terms * Classification of plant machinery * Functionality * Power units * Use/Application * Manufacturer * Versatility | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Identify task and machine to be operated | * Meaning of terms * Factors to be considered in selection of plant machinery e.g * Efficency * Cost * Versatiliy * Power units * Maintenance requirements * Environmental factors | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Operate identified plant machinery | * Meaning of terms * Safety, checks and precautions in the operation of the machine * Operation procedures of plant machine * Statutory requirements in operation of plant machinery * Manufacturers manual in operation of plant machinery | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Maintain and test plant machinery | * Meaning of Terms * Safety measures in machine maintenance and testing process * Troubleshooting of plant machinery * Maintenance and testing procedures * Manufacturers manuals in testing and maintenance | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Prepare and document plant operation and maintenance reports | * Report preparation * Report dissemination * Report filing | * 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
* Manufacturers’ catalogues
* National and international standards

## REFRIGERATION AND AIR CONDITIONING SYSTEMS

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

**Relationship to Occupational Standards**

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

**Duration of Unit:** 130 hours

**Unit Description**

This unit covers the competencies required to install refrigeration and air conditioning system. . Competencies includes; conducting site survey for installation, installing electrical wiring for refrigeration and air conditioning system, installing refrigeration and air conditioning system, testing and commissioning of the installed system and documenting refrigeration and air conditioning installation report.

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**Summary of Learning Outcomes**

1. Assemble refrigeration and air conditioning tools, equipment and materials
2. Install electrical wiring for refrigeration and air conditioning
3. Install refrigeration and air conditioning system
4. Test and commission installed system
5. Document refrigeration and air conditioning installation report

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Assemble refrigeration and air conditioning tools, equipment and materials | * Meaning of term * 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 * Workshop procedures and techniques of assembling tools, equipment and materials * Safety in tools equipment and material handling. | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Install electrical wiring for refrigeration and air conditioning | * Meaning of terms * National and international standards in installation * Types of wiring systems * Electrical circuit diagrams | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Install refrigeration and air conditioning system | * Meaning of terms * Components and materials in refrigeration and air conditioning system * Safety measures and precautions during installation of installation of refrigeration and air conditioning system * Refrigeration and air conditioning systems installation procedures * Inspection of installed system | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Test and commission installed system | * Meaning of terms * Types of tests * Voltage and current tests * Temperature and flow rate * Noise and vibrations tests * Commissioning of the installed systems | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Document refrigeration and air conditioning installation report | * Report preparation * Report dissemination * Report filing | * 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
* National and international standards
* Printers
* Manuals
* Relevant catalogues

## PLANT MAINTENANCE

**UNIT CODE:** ENG/OS/PS/CR/08/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform plant maintenance

**Duration of Unit:** 110 hours

**Unit Description**

This unit covers the competencies required to perform plant maintenance. Competencies includes: establishing need for plant maintenance, assembling maintenance tools, equipment and materials, carrying out maintenance, testing-maintained equipment and documenting maintenance report.

**Summary of Learning Outcomes**

1. Establish need for plant maintenance
2. Assemble maintenance tools, equipment and materials
3. Decommission plant equipment
4. Carry out maintenance
5. Test maintained equipment
6. Document maintenance report

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Establish need for plant maintenance | * Meaning of terms * Types of plant maintenance * Types of tests to be carried out on a mechanical plant * Manufacturers manuals in plant testing and maintenance |  |
| 1. Assemble maintenance tools, equipment and materials | * Meaning of terms * Checklist in plant maintenance * Preparation of checklists in plant maintenance * Components of a maintenance checklists * Purpose of the checklist in plant maintenance * Maintenance tools, equipment and materials * Identification of tools, equipment and materials * Reconfiguration of tools and equipment * Assembling of maintenance materials * Workshop procedures and guidelines in assembling tools, equipment and materials * Manufacturers manuals in plant maintenance * Safety in handling tools, equipment and materials | * Observation * Written tests * Oral questioning |
| 1. Decommission plant equipment to be maintained | * Meaning of terms * Safety rules in plant decommissioning * Manufacturers manuals in plant decommissioning * Plant decommissioning procedures * Organization policy in the plant equipment decommissioning | * Oral questioning * Written tests * Practical test |
| 1. Carry out maintenance | * Meaning of terms * Types of plant maintenance * Types of tests to be carried out on a mechanical plants * Manufactures manual in plant testing and maintenance * Safety in plant maintenance * Maintenance activities e.g * Repair/Replacement * Troubleshooting * Fault diagnosis procedures * Cleaning * Oiling * Greasing * Plant Maintenance waste disposal | * Observation * Oral questioning * Written tests |
| 1. Test maintained plant equipments | * Meaning of terms * Safety involved in plant and component testing * Types of tests carried out in various types of plant maintenance * Plant testing procedures * Use of manufacturers manuals in plant testing | * Oral questioning * Written tests * Practical test |
| 1. Document plant maintenance report | * Meaning of terms * Maintenance report preparation procedures * Dissemination of maintenance report * Filing of maintenance report | * Written tests * Oral questioning * Practical tests |

**Suggested Methods of Delivery**

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

**Recommended Resources**

* Computer
* Stationery
* Projectors
* Manuals