

**REPUBLIC OF KENYA**

**COMPETENCY BASED CURRICULUM**

**FOR**

**PLANT AND SERVICE ENGINEERING LEVEL 6**



TVET CDACC

P.O BOX 15745-00100

NAIROBI

First published 2019

Copyright © TVET CDACC

All rights reserved. No part of this curriculum may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods without the prior written permission of the TVET CDACC, except in the case of brief quotations embodied in critical reviews and certain other non-commercial uses permitted by copyright law. For permission requests, write to the Council Secretary/CEO, at the address below:

**Council Secretary/CEO**

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

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

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

## 

# FOREWORD

The provision of quality education and training is fundamental to the Government’s overall strategy for social economic development. Quality education and training will contribute to achievement of 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 ii](#_Toc9453779)

[PREFACE iii](#_Toc9453780)

[ACKNOWLEDGEMENT iv](#_Toc9453781)

[ACRONYMNS AND ABBREVIATIONS vi](#_Toc9453782)

[KEY TO UNIT CODE vii](#_Toc9453783)

[OVERVIEW viii](#_Toc9453784)

[BASIC UNITS OF LEARNING 1](#_Toc9453785)

[COMMUNICATION SKILLS 2](#_Toc9453786)

[DIGITAL LITERACY 5](#_Toc9453787)

[ENTREPRENEURIAL SKILLS 8](#_Toc9453788)

[EMPLOYABILITY SKILLS 11](#_Toc9453789)

[ENVIRONMENTAL LITERACY 15](#_Toc9453790)

[OCCUPATIONAL SAFETY AND HEALTH PRACTICES 19](#_Toc9453791)

[COMMON UNITS OF LEARNING 21](#_Toc9453792)

[ENGINEERING MATHEMATICS 22](#_Toc9453793)

[WORKSHOP PROCESSES AND MATERIAL 30](#_Toc9453794)

[PRINCIPLES OF MECHANICAL SCIENCE 35](#_Toc9453795)

[FLUID MECHANICS 38](#_Toc9453796)

[THERMODYNAMICS 40](#_Toc9453797)

[MATERIAL SCIENCE AND METALLURGICAL PROCESSES 43](#_Toc9453798)

[ELECTRICAL PRINCIPLES 47](#_Toc9453799)

[TECHNICAL DRAWING 49](#_Toc9453800)

[CORE UNITS OF LEARNING 52](#_Toc9453801)

[INSTALLATION OF MECHANICAL PUMPS AND COMPRESSORS 53](#_Toc9453802)

[HYDRAULIC AND PNEUMATIC SYSTEMS 57](#_Toc9453803)

[OPERATION AND MAINTENANCE OF PLANT MACHINERY 61](#_Toc9453804)

[REFRIGERATION AND AIR CONDITIONING SYSTEMS 65](#_Toc9453805)

[PLANT MAINTENANCE 67](#_Toc9453806)

[PLANT OVERHAUL MAINTENANCE 70](#_Toc9453807)

[MECHANICAL PROJECT MANAGEMENT 72](#_Toc9453808)

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

A Control Version

# KEY TO UNIT CODE

ENG/CU/PS/BC/01/6/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 technician with the competencies required to perform various duties as outlined in this 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 | Communication skills | 40 | 4 |
| ENG/CU/PS/BC/02/6 | Digital Literacy | 60 | 6 |
| ENG/CU/PS/BC/03/6 | Entrepreneurial skills | 100 | 10 |
| ENG/CU/PS/BC/04/6 | Employability skills | 80 | 8 |
| ENG/CU/PS/BC/05/6 | Environmental literacy | 40 | 4 |
| ENG/CU/PS/BC/06/6 | Occupational safety and health practices | 40 | 4 |
| **Total** | | **360** | **36** |

**Common Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/PS/CC/01/6 | Engineering mathematics | 120 | 12 |
| ENG/CU/PS/CC/02/6 | Workshop process and material | 80 | 8 |
| ENG/CU/PS/CC/03/6 | Principles of mechanical science | 90 | 9 |
| ENG/CU/PS/CC/04/6 | Fluid mechanics | 100 | 10 |
| ENG/CU/PS/CC/05/6 | Thermodynamics principles | 100 | 10 |
| ENG/CU/PS/CC/06/6 | Material science and metallurgical process | 90 | 9 |
| ENG/CU/PS/CC/07/6 | Electrical principles | 90 | 9 |
| ENG/CU/PS/CC/07/6 | Technical Drawing | 90 | 9 |
| **Total** | | **760** | **76** |

**Core Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/PS/CC/01/6 | Installation of mechanical pumps and compressors | 120 | 12 |
| ENG/CU/PS/CC/02/6 | Hydraulic and pneumatic systems | 130 | 13 |
| ENG/CU/PS/CC/03/6 | Operation and maintenance of plant machinery | 120 | 12 |
| ENG/CU/PS/CC/04/6 | Refrigeration and air conditioning system | 80 | 8 |
| ENG/CU/PS/CC/05/6 | Plant Maintenance | 100 | 10 |
| ENG/CU/PS/CC/06/6 | Plant overhaul maintenance | 190 | 19 |
| ENG/CU/PS/CC/07/6 | Mechanical project management | 90 | 9 |
|  | Industrial Attachment | 480 | 48 |
| **Total** | | **1,310** | **131** |
| **Grand Total** | | **2,430** | **243** |

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

The total duration of the **course is 2,430 hours** (81 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 C- (C minus)

**Or**

1. Level 5 certificate in a 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 480 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 Technician Level 6, 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/01/6 **/**A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate communication skills

**Duration of Unit:** 30 hours

**Unit Description**

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

**Summary of Learning Outcomes**

1. Utilize specialized communication skills processes
2. Develop communication strategies
3. Establish and maintain communication pathways
4. Promote use of communication strategies
5. Conduct interview
6. Facilitate group discussion
7. Represent the organization

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. 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 * Types of communication strategies * Elements of communication strategy | * Written test * Oral * Practical tests |
| 1. Develop communication strategies | * Dynamics of groups * Styles of group leadership * Openness and flexibility in communication * Communication skills relevant to client groups | * Observation * Written tests * Practical tests |
| 1. Establish and maintain communication pathways | * Types of communication pathways | * Written tests * Observation |
| 1. Promote use of communication strategies | * Application of elements of communication strategies * Effective communication techniques | * Written tests * Observation |
| 1. Conduct interview | * Types of interview * Establishing rapport * Facilitating resolution of issues * Developing action plans | * Written tests * Observation |
| 1. Facilitate group discussion | * Identification of communication needs * Dynamics of groups * Styles of group leadership * Presentation of information * Encouraging group members participation * Evaluating group communication strategies | * Written tests * Observation * Practical tests |
| 1. Represent the organization | * Presentation techniques * Development of a presentation * Multi-media utilization in presentation * Communication skills relevant to client groups | * Observation * Written tests |

**Suggested Delivery Methods**

* Interview
* Role playing
* Observation

**Recommended Resources**

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

# 

# DIGITAL LITERACY

**UNIT CODE:** ENG/CU/PS/BC/02/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate digital literacy

**Duration of Unit:** 70 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 and software
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/03/6/A

**Relationship to occupational standards**

This unit addresses the unit of competency: Demonstrate entrepreneurial skills

**Duration of unit:** 80 hours

**Unit description**

This unit describes the competencies critical to demonstration of entrepreneurial aptitudes. It involves, developing business innovation strategies, developing new markets, customer base, expanding employed capital and undertaking regional/county expansion while retaining motivated staff.

**Summary of Learning Outcomes**

1. Develop business innovation strategies
2. Develop new products/ markets
3. Expand customers and product lines
4. Motivate all staff/workers
5. Expand employed capital base
6. Undertake regional/county business expansion

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Develop business Innovation strategies | * Innovation in business * Business innovation strategies * Creativity for business development * New technologies in entrepreneurship * Linkages with other entrepreneurs * Setting strategic directions * New ideas and approaches * Entrepreneurial skills development * Market trends * Monitoring and anticipating market trends * Products and processes in entrepreneurship * Business conventions ad exhibitions * Business growth refocus | * Observation * Case studies * Individual/group assignments   Projects   * Written * Oral |
| 1. Develop new products/ markets | * Feasibility study for new products * Identifying new sources of raw material and resources * New target markets/customers * Increasing products and services * Marketing improvement * Intrapreneurship and business growth | * Observation * Case studies * Individual/group assignments * projects * Written * Oral |
| 1. Expand customers and product lines | * Market demand * Regulatory environment * Creating product and services competitive advantages * Creating royal client base * Identifying and maintain new customers and markets * Advance product/ service promotions * Advance market expansion * Small business records management * Book keeping and auditing for small businesses * Computer application software and programmes * ICT in customer and product diversification | * Oral * Observation * Case studies * Individual/group assignments * projects * Written |
| 1. Motivate staff/workers | * Motivation of workers   `Communication at workplace for motivation purpose   * Problem solving * Conflict resolution at place of work * Good staff/workers relation * Team building and team work * Staff development and enhancement * Culture of continuous improvement | * Observation * Case studies * Individual/group assignments * projects * Written |
| 1. Expand employed capital base | * Employed capital in business * Business share holdings * Types of shares * Shares diversification * Role of shareholders * Intrapreneurship * Increasing products and services | * Observation * Case studies * Individual/group assignments * projects * Written * Oral |
| 1. Undertake county/ regional business expansion | * Region/ county identification process * Regional/ county laws and regulation * Business regional/county expansion * Regional/ County business expansion * Innovation in business * Business expansion and diversification * Resources for regional/county expansion * Small business Strategic Plan * Computer software in business development * ICT and business growth | * Observation * Case studies * Individual/group assignments * Projects * Written * Oral |

**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
* Laptop/ desktop computers
* Internet
* Telephone
* Writing materials

# EMPLOYABILITY SKILLS

**UNIT CODE:** ENG/CU/PS/BC/04/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate employability skills

**Duration of Unit:** 60 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 * Integrating personal 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/proactivity * 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/05/6/A

**Relationship to Occupational Standards**:

This unit addresses the unit standard: Demonstrate environmental literacy

**Duration of Unit:** 30 hours

**Unit Description**

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

**Summary of Learning Outcomes**

1. Control environmental hazard
2. Control environmental Pollution
3. Demonstrate sustainable resource use
4. Evaluate current practices in relation to resource usage
5. Identify Environmental legislations/conventions for environmental concerns
6. Implement specific environmental programs
7. Monitor activities on Environmental protection/Programs
8. Analyse resource use
9. Develop resource conservation plans

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

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

**Suggested Delivery Methods**

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

**Recommended Resources**

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

# OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE:** ENG/CU/PS/BC/06/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit:** 40 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Identify workplace hazards and risks | * Identification of hazards in the workplace and/or the indicators of their presence * Evaluation and/or work environment measurements of OSH hazards/risk existing in the workplace * Gathering of OSH issues and/or concerns | * Oral questions * Written tests * Observation of trainees identify hazards and risks |
| 1. Identify and implement appropriate control measure to hazards and risks | * Prevention and control measures e.g. use of PPE * Contingency measures | * Oral questions * Written tests * Practical tests * Observation of implementation of control measures |
| 1. Implement OSH   programs, procedures  and policies/guidelines | * Organization OSH program, procedures and policies/guidelines * Implementation of OSH procedures and policies/ guidelines * Training of team members and advice on OSH standards and procedures * Implementation of procedures for maintaining OSH-related records | * Oral questions * Written tests * Practical test * Observation |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

# COMMON UNITS OF LEARNING

# ENGINEERING MATHEMATICS

**UNIT CODE:** ENG/CU/PS/CC/01/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply Engineering mathematics

**Duration of Unit:** 120 hours

**Unit Description**

This unit describes the competencies required by a mechanical plant and service technician to apply a wide range of Engineering mathematics in their work. This includes applying algebraic functions, trigonometry and hyperbolic functions, complex numbers, coordinate geometry, binomial expansion, calculus, ordinary differential equations, laplace transforms, power series, Statistics, Fourier series, vector theory, matrix, numerical methods, probability, commercial calculations, estimations and measurements 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. Solve Ordinary differential equations
8. Apply Laplace transforms
9. Apply Power Series
10. Apply Statistics
11. Apply Fourier Series
12. Apply Vector theory
13. Apply Matrix
14. Apply Numerical methods
15. Apply concept of probability for work
16. Perform commercial calculations
17. 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 * Factor 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 * Osborne’s Rule * Ashx+bshx=C equation * One-to-one relationship in functions * Inverse functions for one-to-one relationship * Inverse functions for trigonometric functions * Graph of inverse functions * Inverse hyperbolic functions | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 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 De Moivre’s theorem * 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 * Methods of integration application of integration. * Integrals of hyperbolic and inverse functions | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 1. Solve Ordinary differential equations | * Types of first order differential equations * Formation of first order differential equation * Solution of first order differential equations * Application of first order differential equations * Formation of second order differential equations for various systems * Solution of second order differential equations * Application of second order differential equations | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 1. Apply Laplace transforms | * Meaning of Laplace transforms deriving Laplace transforms from first principles * State properties of Laplace transform * Determination of inverse LT of simple transforms and partial fractions * Solution of differential equation by LT * Solution of simultaneous differential equation by given initial conditions | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * 1. Apply Power Series | * Meaning of the term power series * Taylor’s theorem * Deduction of Maclaurin’s theorem to obtain power series * Application of Taylor’s theorem and Maclaurin’s theorems in numerical work | * 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   * Definition of probability * Laws of probability * Expectation variance and S.D. * Types of distributions * Mean, variance and SD of probability distributions * Application of probability distributions | * Assignments * Oral questioning * Supervised exercises * Written tests * Simulation * Data modelling |
| * 1. Apply Fourier Series | * Determination of the Fourier series as a periodic function of the period 2π and extend to π * Determination of Fourier series of non-periodic functions over a given range * Determination of Fourier series for even and odd functions and the half-range series for a given function | * Assignments * Oral questioning * Supervised exercises * Written tests |
| * 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 * Definition of Gradient, Divergence and curl * Solutions of involving Gradient, Divergence and curl * Application of vectors | * Assignments * Oral questioning * Supervised exercises * Written tests |
| * 1. Apply Matrix methods | * Matrix operation * Determinant of 3x3 matrix * Inverse of 3x3 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

# WORKSHOP PROCESSES AND MATERIAL

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

**Relationship to Occupational Standards:**

This unit addresses the unit of competency: Perform workshop processes and material

Duration of Unit: 80 Hours

**Unit description**

This unit covers the competencies required by a plant and service engineering technician to perform workshop processes and materials. Competencies includes; Demonstration of the understanding of workshop processes, workshop machines, workshop materials, fabricating farm tools and equipment, preparing and documenting workshop activities and reports and then maintaining farm machinery and workshop tools and equipment.

**Summary of Learning Outcome**

1. Demonstrate understanding of workshop procedures
2. Demonstrate understanding of workshop machines
3. Demonstrate understanding of workshop materials
4. Fabricate mechanical tools and equipment
5. Prepare and document workshop activities reports
6. Maintain plant machinery and workshop tools and equipment

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Demonstrate understanding of workshop procedures | * Meaning of terms * Types of workshop * Workshop rules, procedures and regulations * Purposes of workshop in various engineering operations * Workshop tools, equipment and materials * Types * Function * Classification * Application | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Demonstrate understanding of workshop machines | * Meaning of terms * Various types of workshop machines * Functions and operation of workshop machines * Maintenance of workshop machines | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Demonstrate understanding of workshop materials | * Workshop materials * Types of workshop materials * Classification of workshop materials * Properties and application of workshop materials * Storage of various types of workshop materials * Preparation of workshop materials * Safety precautions in workshop material handling | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Fabricate mechanical tools and equipment | * Meaning of terms * Types of mechanical equipment to be fabricated * Design of mechanical equipment before workshop fabrication process * Fabricating tools, equipment and machines * Fabrication process and testing | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Prepare and document workshop activities reports | * Types of reports * Report preparation and dissemination * Filing of workshop report | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Maintain farm machinery and workshop tools and equipment | * Meaning of terms * Types of farm maintenance and their application * Factors to be considered in maintenance of farm machinery and equipment * Manufacturers manuals in maintenance of farm machinery * Workshop rules and procedures in maintenance of farm machinery and equipment | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |

**Suggested Delivery Methods**

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

**List of Recommended Resources**

* 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/03/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit:** 90 hours

**Unit Description**

This unit describes the competencies required by a technician in order to apply a wide range of principles of mechanical science in their work. Competencies includes; determining forces in a system, demonstrating knowledge of moments, demonstrating understanding of friction principles, demonstrating understanding of motion, understanding friction principles, understanding of motions in engineering, describing work, energy and power, performing machine calculations, demonstrating understanding of gas principles, applying heat knowledge, density knowledge and pressure principles.

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + 1. Determine forces in a system | * Meaning of terms * Types of forces * Discussion and analysis of various types of forces * Conversion and SI units of various parameters * Force * Work * Mechanical advantage * Efficiency * Energy * Force theorem * Determination of resultant of coplanar forces * Application of different types of forces | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * + 1. Demonstrate the knowledge of moments | * Meaning of terms * Meaning and calculation of moment * Principles of moment * Identification and application of couples | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * + 1. Demonstrate understanding of friction principles | * Meaning of terms * Laws of friction * Calculation of limiting friction * Calculations of coefficients of friction * Advantage and disadvantages of friction. | * Assignments * Oral questioning * Supervised exercises * Written tests |
| * + 1. Demonstrate understand of motions in engineering | * Meaning of terms * Motion concept * Laws of motion * Calculation of motion | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| * + 1. Describe work, energy and power | * + Meaning of terms * Work * Energy * Power * Calculation of work, energy and power | * Assignments * Supervised exercises * Written tests * Practical test |
| * + 1. Perform machine calculations | * + Meaning of terms   + Laws of machines   + Solutions on problems involving simple machines   + Solution of problems on levers | * Assignments * Supervised exercises * Written tests * Practical test |
| * + 1. Demonstrate understanding of gas principles | * + Meaning of terms   + Gas Laws   + Importance of gas laws in engineering   + Application of gas laws in engineering | * Assignments * Supervised exercises * Written tests * Practical test |
| * + 1. Apply heat knowledge | * + Meaning of terms   + Heat concept   + Working principles of heat   + Heat capacity   + Solution of problems on heat | * Assignments * Supervised exercises * Written tests * Practical test |
| * + 1. Apply density knowledge | * + Meaning of terms   + Measurements of density   + Solutions on density problems | * Assignments * Supervised exercises * Written tests * Practical test |
| * + 1. Apply pressure principles | * + Meaning of terms   + Discussions on pressure concept   + Working principles of pressure   + Solutions of pressure problems   + Application of pressure | * 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/03/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit:** 100 hours

**Unit description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Demonstrate understanding of flow in fluids | * + Meaning of terms   + Flow rate in pipes   + 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 | * + Meaning of terms   + 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 | * + Meaning of terms   + 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   + 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

**THERMODYNAMICS**

**UNIT CODE:** ENG/CU/AGR/CC/04/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply thermodynamics principles

**Duration of Unit:** 100 hours

**Unit description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Understand fundamentals of thermodynamics | * + Terms used in thermodynamics   + Thermodynamics processes and cycles * First law of thermodynamics | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. Perform steady flow processes | * + Deriving Steady flow energy equation   + Applying Steady flow energy equation   + Application of Steady flow energy equation in utilities | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. Perform non steady flow processes | * + Deriving non-flow energy equation * Application of Non-flow energy equation in problem solving | * Assignments * Oral questioning * Supervised exercises * Written tests |
| 1. Understand perfect gases | * + State Perfect gas laws   + Carrying out Gas laws experiment * Application of Gas laws | * Assignments * Oral questioning * Supervised exercises * Written tests |
| 1. Generate steam | * + Determining Dryness fraction   + Determining Relationship between pressure and boiling point   + Carrying out Energy balance   + Determining Relationship between temperature and pressure | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises |
| 1. Perform thermodynamics reversibility and entropy | * + Thermodynamics reversibility principles   + Principles of heat engine   + Second law of thermodynamics   + Entropy in thermodynamics | * Assignments * Oral questioning * Observation * Supervised exercises |
| 1. Understand idea gas cycle | * + Ideal gas cycle processes   + Air standard efficiency and actual efficiency are differentiated   + Problems are solved in ideal gas cycle | * Assignments * Oral questioning |
| 1. Demonstrate fuel and combustion | * + Classification of fuels   + Properties of fuels   + Deriving of Combustion equation   + Application of Combustion equation | * Oral questioning * Practical tests * Observation * Supervised exercises |
| 1. Perform heat transfer | * + Deriving Conduction equation from Fourier’s law   + Heat transfer equation is derived and applied from Newton’s law of cooling and Fourier’s law | * Assignments * Oral questioning |
| 1. Understand heat exchangers | * + Classification of Heat exchangers   + Recuperative heat exchangers are described   + Application of Heat equations | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises |
| 1. Understand air compressors | * + Classification of Air compressors   + Types of air compressors   + Deriving and applying Equations of reciprocating compressors | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises |
| 1. Understand gas turbines | * + Theoretical cycle for gas turbines   + Open cycle gas turbine   + Closed cycle gas turbine   + Deriving Gas turbine equations | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises |
| 1. Understanding impulse steam turbines | * + Principles of operations of the impulse steam turbines   + Deriving and applying Impulse steam turbine equation | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

**MATERIAL SCIENCE AND METALLURGICAL PROCESSES**

**UNIT CODE:** ENG/CU/PS/CC/05/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit:** 90 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/06/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply Electrical principles

**Duration of Unit:** 90 hours

**Unit Description**

This unit describes the competencies required by a technician in order to apply a wide range of Electrical principles in their work; use the concept of basic Electrical quantities, use the concepts of D.C and A.C circuits in electrical installation, use of basic electrical machine, use of earthing in Electrical installations and apply lightning protection measures

**Summary of Learning Outcomes**

1. Use the concept of basic Electrical quantities
2. Use the concepts of D.C and A.C circuits in electrical installation
3. Use 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 * AC to DC and DC to AC Conversion * Basic solar photovoltaic systems | * 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 * Special machines and their Applications * Electric Drives | * 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 |

**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:** 90hours

**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 * Identification and care of drawing 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 * 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. cylinders, prisms 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 * Assembly drawing | * 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 electrical drawings | * Electrical symbols and abbreviations * Meaning of electrical 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 * Electrical e.g. block, schematic, circuit, line and wiring | * 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

# 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 compressors. Competencies include; conducting site survey, designing installation layout, preparing installation layout, installing identified pumps and test running installed pumps, maintenance reports.

**Summary of Learning Outcomes**

1. Conduct site survey
2. Design installation layout
3. Prepare installation layout
4. Install identified pump and compressors
5. Test run installed pump and compressors
6. Prepare and document pump installed report

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| * + - 1. Conduct site survey | * Meaning terms * Methods of conducting site survey in installation of mechanical pumps and compressors * Factors to consider when conducting site survey in installation of mechanical pumps and compressors * Types of mechanical pumps and their specifications * Types of compressors and their specifications | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Design installation layout | * Meaning of terms * Pump design and operation characteristics * Manufacturers recommendations in designing of installation layout * Factors to consider in designing pump installation layout * Types of pump installation foundations | * 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 compressor installation * Types of fasteners and fitting in pump and compressors installation * Pump and compressors installations alignment * Fluid flow in pump installation | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Test run and commission of installed pump and compressors | * Meaning of terms * Various types of checks carried out after pump and compressors installation * Various pump and compressors installation adjustments * Pump installation commissioning * Basic pump installation maintenance | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Prepare and document pump installed 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/02/6/A

**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, designing installation layout, preparing 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. 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. Design installation layout | * Meaning of terms * Factors to be considered in design of the systems layout * Safe ergonomics working conditions * Auxiliary components consideration during design | * 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 and commission 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 * Commissioning | * 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/03/6/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, evaluating machines performance, 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. Evaluate machines performance
    5. Maintain and test plant machinery
    6. 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. Evaluate machines performance | * Meaning of terms * Manufacturers manuals in evaluation of machine performance * Efficiency and effectiveness of machinery * Machine reliability * National and international standards in machine evaluation | * 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 * National and international standards | * 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/04/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit:** 80 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.

.

**Summary of Learning Outcomes**

1. Conduct site survey
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. Conduct site survey | * Meaning of term * Tools and equipment used in site survey * Factors considered in conducting site survey * Methods used in conducting site survey * Preparation of survey report | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Install electrical wiring for refrigeration and air conditioning | * Meaning of terms * Electrical installation tools and equipment * 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 * Tools, equipment, 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 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/05/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform plant maintenance

**Duration of Unit:** 100 hours

**Unit Description**

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

**Summary of Learning Outcomes**

1. Establish need for plant maintenance
2. Prepare maintenance schedule
3. Assemble maintenance tools, equipment and materials
4. Establish maintenance team
5. Carry out maintenance
6. Test maintained equipment
7. 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 plants * Manufactures manual in plant testing and maintenance * Plant efficiency | * Written tests * Oral questioning * Practical tests |
| 1. Prepare maintenance schedule | * Meaning of terms * Preparation of maintenance schedule * Factors to be considered in preparation of maintenance schedule e.g * Time * Scope * Plant complexity * Checklist in plant maintenance * Preparation of checklists in plant maintenance * Components of a maintenance checklists * Purpose of the checklist in plant maintenance | * Oral questioning * Written tests * Practical tests |
| 1. Assemble maintenance tools, equipment and materials | * Meaning of terms * 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. Establish maintenance team | * Meaning of terms * Tasks involved in plant maintenance * Expertise and work scope in plant maintenance * Relevant of organization structure in plant maintenance * Factors to be considered in establishment of plant maintenance e.g * Timelines | * Observation * Oral questioning * Written tests |
| 1. Carry out maintenance | * Meaning of terms * 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. Commission maintained plant equipment | * Meaning of terms * Safety in plant commissioning * Plant commissioning procedures * Documents used in plant commissioning * Permit to work * Manufacturers manual * Organization policy | * 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

**PLANT OVERHAUL MAINTENANCE**

**UNIT CODE:** ENG/OS/PS/CR/06/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform plant overhaul maintenance

**Duration of Unit:** 190 hours

**Unit Description**

This unit covers the competencies required in performing plant overhaul maintenance.Competencies includes; preparing plant overhaul schedule, assembling maintenance tools, equipment, materials and manufacturers manuals, establishing plant maintenance team, decommissioning plant activities, performing overhaul maintenance with equipment testing, performing plant test-running and preparing and documenting plant overhaul maintenance report.

**Summary of Learning Outcomes**

1. Prepare plant overhaul schedule
2. Assembly maintenance tools, equipments ,materials and manufacturers manual
3. Establish plant maintenance team
4. Decommission plant activities
5. Perform overhaul maintenance and equipment testing
6. Perform plant test-running
7. Prepare and document plant overhaul maintenance report

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Prepare plant overhaul schedule | * Meaning of terms * Various maintenance activities and procedures * Disassembling * Service/Repair/Replace * Assembling * Preparation of maintenance schedule * Preparation of maintenance checklist | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Assembly maintenance tools, equipments ,materials and manufacturers manual | * Meaning of terms * Types of maintenance tools, materials and equipment * Safety on tool, materials and equipment handling | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Establish plant maintenance team | * Meaning of terms * Maintenance tasks * Relevant expertise and the scope of work * Maintenance timelines | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Decommission plant activities | * Meaning of terms * Various decommissioning methods * Safety standards in decommissioning process | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Perform overhaul maintenance and equipment testing | * Meaning of terms * Safe work procedures * Maintenance activities * Dismantling * Repair and service of components * Assembly * Inspection of the plant * Components testing | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Perform plant test-running | * Meaning of terms * Various types of checks are carried out after plant overhaul * Various parameters adjustments * Plant re-commissioning | * Observation * Oral questioning * Written tests * Practical tests |
| 1. Prepare and document plant overhaul maintenance report | * Report preparation * Report dissemination * Report sharing | * Observation * Oral questioning * Written tests * Practical tests |

**Suggested Methods of Delivery**

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

**Recommended Resources**

* Stationery
* Computers
* Printers
* Cameras
* Phones
* Internet

# MECHANICAL PROJECT MANAGEMENT

**UNIT CODE:** ENG/OS/PS/CR/07/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Manage mechanical project

**Duration of Unit:** 90 hours

**Unit Description**

This unit covers the competencies required to secure software application Competencies includes; preparation of work plans and policies, managing project team, managing material, tools and equipment, managing project budget, supervising and assessing project implementation, preparing project reports and commissioning.

**Summary of Learning Outcomes**

1. Prepare work plans and policies
2. Manage Project team
3. Manage materials, tools and equipment
4. Manage project budget
5. Supervise and assess project implementation
6. Prepare project reports
7. Commission project

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Prepare work plans and policies | * Meaning of terms * Project planning * Elements of project planning * Factors to consider in project planning * Project Objectives e.g. SMART * Project life cycle * Initiation * Planning * PERT * CPM * Execution * Closure * Project policies | * Written tests * Oral questioning * Practical tests |
| 1. Manage Project team | * Meaning of terms * Project personnel * Work break down structure * SWOT analysis * Project organization structure * Training of the project team * EHS Standards in project | * Oral questioning * Written tests * Practical tests |
| 1. Manage materials, tools and equipment | * Identification of tool, materials and equipment in a project * Classification and maintenance of tools, materials and equipment * Tools, materials and equipment inventory system | * Observation * Written tests * Oral questioning |
| 1. Manage project budget | * Meaning of terms * Project Budgetary process * Elements of the budget * Project cost management (PCM) | * Observation * Oral questioning * Written tests |
| 1. Supervise and assess project implementation | * Meaning of terms * Project cycle * Project monitoring and evaluation * Project quality control | * Observation * Oral questioning * Written tests |
| 1. Prepare project reports | * Project report * Preparation of the project report e.g. * Progress reports * Completion report * Elements of report * Documentation of the project report and operation manual | * Oral questioning * Written tests * Practical test |
| 1. Commission project | * Completion certificate * Importance * Components * Handover documents * User manuals | * 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