

**COMPETENCY BASED CURRICULUM**

**FOR**

**MECHANICAL PLANT ENGINEERING**

**LEVEL 5**



TVET CDACC

P.O BOX 15745-00100

NAIROBI

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# FOREWORD

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

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted to the formulation of the Policy Framework for Reforming Education and Training (Sessional Paper No. 4 of 2016). 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 Engineering 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 and the Sessional Paper No. 4 of 2016 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) and other stakeholders have developed this curriculum.

This curriculum has been developed following the CBET framework policy; the CBETA Standards and guidelines provided by the TVET Authority and the Kenya National Qualification framework designed by the Kenya National Qualification Authority.

The 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, Plant Engineering SSAC, expert workers and all those who participated in the development of this curriculum.

**Prof. CHARLES M. M. ONDIEKI, PhD, FIET (K), Con. EngTech.**

**CHAIRMAN, TVET CDACC**

# ACKNOWLEDGMENT

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 appreciate Plant Engineering Sector Skills Advisory Committee (SSAC) who enabled the development of this curriculum.

I recognize with appreciation the role of the SSAC in ensuring that competencies required by the industry are addressed in this curriculum. I also thank all stakeholders in the Mechanical Plant 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 Engineering sector acquire competencies that will enable them to perform their work more efficiently.

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

**COUNCIL SECRETARY/CEO**

# ACRONYMS

AC Air conditioning

BC Basic Competency

CC Common Competency

CR Core Competency

CDACC Curriculum Development, Assessment and Certification Council

CPU Control Powering Unit

CU Curriculum

DTI Dial test indicator

ENG Engineering

FOT Fixed orifice tube

GPS Global positioning system

ICT Information and Communication Technology

IT Information Technology

KCSE Kenya Certificate of Secondary Education

MPE Mechanical Plant Engineering

KNQF Kenya National Qualification Framework

KPI King Pin inclination

OBD On-board diagnostics

OS Occupational Standards

PPE Personal protective equipment

SI Spark ignition

TVET Technical and Vocational Education and Training

TQM Total Quality Management

SOP Standard Operating Procedures

# **KEY TO UNIT CODE**

 **ENG/CU/MPE/BC /01/ 5/A**

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

Version

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# COURSE DESCRIPTION

The Mechanical Plant Technology Level 5 qualification consists of competencies that a person must achieve to enable him/her to workin a production plant. It entails installing mechanical plant machineries, performing plant maintenance, maintaining hydraulic and pneumatic systems, operating plant machines/utilities, performing workshop processes and managing spares and consumables inventory.

The units of competency comprising Mechanical Plant Technology level 5 qualifications include the following basic, common and core competencies:

|  |
| --- |
| **BASIC UNITS OF COMPETENCY** |
| **Unit of Learning Code**  | **Units of Learning Title**  | **Duration in Hours**  | **Credits Factors** |
| **ENG/CU/MPE/BC/01/5/A** | Communication skills | 25 | 2.5 |
| **ENG/CU/MPE/BC/02/5/A** | Digital literacy | 45 | 4.5 |
| **ENG/CU/MPE/BC/03/5/A** | Entrepreneurial skills | 70 | 7.0 |
| **ENG/CU/MPE/BC/04/5/A** | Employability skills | 50 | 5.0 |
| **ENG/CU/MPE/BC/05/5/A** | Environmental literacy | 25 | 2.5 |
| **ENG/CU/MPE/BC/06/5/A** | Occupational health and safety | 25 | 2.5 |
| **TOTAL** | **240** | **24.0** |
| **COMMON UNITS OF COMPETENCY** |
| **ENG/CU/MPE/CC/01/5/A** | Technical drawing | 75 | 7.5 |
| **ENG/CU/MPE/CC/02/5/A** | Engineering mathematics | 75 | 7.5 |
| **ENG/CU/MPE/CC/03/5/A** | Mechanical science principles | 60 | 6.0 |
| **ENG/CU/MPE/CC/04/5/A** | Thermodynamics principles | 70 | 7.0 |
| **ENG/CU/MPE/CC/05/5/A** | Fluid mechanics principles | 40 | 4.0 |
| **TOTAL** | **320** | **32.0** |
| **CORE UNITS OF COMPETENCY** |
| **ENG/CU/MPE/CR/01/5/A** | Installation of mechanical plant machinery | 80 | 8.0 |
| **ENG/CU/MPE/CR/02/5/A** | Production plant maintenance | 100 | 10.0 |
| **ENG/CU/MPE/CR/03/5/A** | Hydraulic and pneumatic systems | 70 | 7.0 |
| **ENG/CU/MPE/CR/04/5/A** | Operation of plant machines/utilities | 70 | 7.0 |
| **ENG/CU/MPE/CR/05/5/A** | Manage spares and consumables inventory | 40 | 4.0 |
| **ENG/CU/MPE/CR/06/5/A** | Perform workshop processes | 60 | 6.0 |
|  | Industrial attachment | 360 | 36.0 |
| **TOTAL**  | **780** | **78.0** |
| **GRAND TOTAL** | **1340** | **134.0** |

1. **Entry Requirements**

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

1. Kenya Certificate of Secondary Education (K.C.S.E.) with a minimum mean grade of D+ (D plus)

**Or**

1. Level 4 certificate in a related course.

**Or**

1. Equivalent qualifications as determined by Kenya National Qualifications Authority (KNQA)
2. **Industrial attachment**

An individual enrolled in this course will be required to undergo an industrial attachment in a Mechanical Plant engineering firm for a period of at least three (3) months. An individual enrolled in one of the units of learning will be required to undergo a one-month attachment in a Mechanical plant firm dealing with the relevant competency required. Attachment will be undertaken upon completion of the course or the unit of learning.

1. **Assessment**

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

1. **Certification**

A candidate will be issued with a Record of Achievement on demonstration of competence in a unit of competency. To attain the qualification national certificate in Mechanical Plant Technology Level 5, the candidate must demonstrate competence in all the units of competency as given in qualification pack. These certificates will be issued by TVET CDACC in conjunction with training provider.

# BASIC UNITS OF LEARNING

##

## COMMUNICATION SKILLS

**UNIT CODE:** ENG/CU/MPE/BC/01/5/A

**Relationship to Occupational Standards**

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

**Duration of Unit:** 25 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
* Oral
 |
| 1. Establish and maintain communication pathways
 | * Types of communication pathways
 | * Written
* Observation
 |
| 1. Promote use of communication strategies
 | * Application of elements of communication strategies
* Effective communication techniques
 | * Written
* Observation
 |
| 1. Conduct interview
 | * Types of interview
* Establishing rapport
* Facilitating resolution of issues
* Developing action plans
 | * Written
* Observation
 |
| 1. Facilitate group discussion
 | * Identification of communication needs
* Dynamics of groups
* Styles of group leadership
* Presentation of information
* Encouraging group members participation
* Evaluating group communication strategies
 | * Written
* Observation
 |
| 1. Represent the organization
 | * Presentation techniques
* Development of a presentation
* Multi-media utilization in presentation
* Communication skills relevant to client groups
 | * Observation
* Written
 |

**Suggested Delivery Methods**

* Interview
* Role playing
* Observation

**Recommended Resources**

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

##

## DIGITAL LITERACY

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

**Relationship to Occupational Standards**

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

**Duration of Unit:** 45 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

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

**Suggested Delivery Methods**

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

**Recommended Resources**

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

##

## ENTREPRENEURIAL SKILLS

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

**Relationship to occupational standards**

This unit addresses the unit of competency: Demonstrate entrepreneurial skills

**Duration of unit:** 70 hours

**Unit description**

This unit describes the competencies critical to demonstration of entrepreneurial 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
* Entrepreneurship
* 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/MPE/BC/04/5/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: **Demonstrate employability skills**

**Duration of Unit:** 50 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Develop self-awareness and ability to deal with life challenges
 | * Self-awareness
* Formulating personal vision, mission and goals
* Strategies for overcoming life challenges
* Managing emotions
* Emotional intelligence
* Asserting one-self
* Assertiveness versus aggressiveness
* Expressing personal thoughts, feelings and beliefs
* Self esteem
* Developing and maintaining high self-esteem
* Developing and maintaining positive self-image
* Sharing personal feelings
* Setting performance targets
* Monitoring and evaluating performance
* Articulating ideas and aspirations
* Accountability and responsibility
 | * Observation
* Written
* Oral interview
* Third party report
 |
| 1. Demonstrate critical safe work habits for employees
 | * Stress and stress management
* Time concept
* Punctuality and time consciousness
* Leisure
* 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/MPE/BC/05/5/A

**Relationship to Occupational Standards**:

This unit addresses the unit standard: **Demonstrate environmental literacy**

**Duration of Unit:** 25 hours

**Unit Description**

This unit describes the competencies required to control environmental hazard, control environmental pollution, comply with workplace sustainable resource use, evaluate current practices in relation to resource usage, identify environmental legislations/conventions for environmental concerns, implement specific environmental programs, 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
* Analyzing data gathered
* Documentation of recommendations and submission
* Setting of management support systems to sustain and enhance the program
* Monitoring and reporting of environmental incidents to concerned /proper authorities
 | * Oral questions
* Written tests
* Practical test
* Observation
 |
| 1. Analyze resource use
 | * Identification of resource consuming processes
* Determination of quantity and nature of resource consumed
* Analysis of resource flow through different parts of the process.
* Classification of wastes for possible source of resources.
 | * Written tests
* Oral questions
* Practical test
* Observation
 |
| 1. Develop resource Conservation plans
 | * Determination of efficiency of use/conversion of resources
* Causes of low efficiency of use of resources
* Plans for increasing the efficiency of resource use
 | * Written tests
* Oral questions
* Practical test
* Observation
 |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

##

## OCCUPATIONAL SAFETY AND HEALTH PRACTICES

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

**Relationship to Occupational Standards**

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

**Duration of Unit:** 25 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify workplace hazards and risks
 | * Identification of hazards in the workplace and/or the indicators of their presence
* Evaluation and/or work environment measurements of OSH hazards/risk existing in the workplace
* Gathering of OSH issues and/or concerns
 | * Oral questions
* Written tests
* Observation of trainees identify hazards and risks
 |
| 1. Identify and implement appropriate control measure to hazards and risks
 | * Prevention and control measures e.g. use of PPE
* Contingency measures
 | * Oral questions
* Written tests
* Practical tests
* Observation of implementation of control measures
 |
| 1. Implement OSH

 programs, procedures and policies/guidelines | * Company OSH program, procedures and policies/guidelines
* Implementation of OSH procedures and policies/ guidelines
* Training of team members and advice on OSH standards and procedures
* Implementation of procedures for maintaining OSH-related records
 | * Oral questions
* Written tests
* Practical test
* Observation
 |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

# COMMON UNITS OF LEARNING

## TECHNICAL DRAWING

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

**Relationship to Occupational Standards**

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

**Duration of Unit:** 75 Hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

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

**Suggested Methods of Delivery**

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

**Recommended Resources**

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

## ENGINEERING MATHEMATICS

**UNIT CODE:** ENG/CU/MPE/CC/02/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Apply engineering mathematics**

Duration of Unit: 75hours

**Unit Description**

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

**Summary of Learning Outcomes**

1. Use concepts of arithmetic in solving work problems
2. Use common formula and algebraic expressions for work
3. Use trigonometry to solve practical engineering problems
4. Perform estimations, measurements and calculations
5. Apply matrices in work
6. Apply vectors in work
7. Collect, organize and interpret statistical data
8. Apply concepts of probability for work
9. Perform commercial calculations

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

|  |  |  |
| --- | --- | --- |
| Learning Outcome | Content | Suggested Assessment Methods |
| 1. Use concepts of arithmetic in solving work problems
 | * Fundamental operations
* Addition,
* Subtraction,
* Multiplication,
* Division of positive and negative numbers
* Fractions and decimals operations and conversions
* Indices
* Ratios and proportions
* Meaning
* Conversions into percentages
* Direct and inverse proportions determination
* Use of scientific calculator
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Use formulae and algebraic expressions for work
 | * + Algebraic linear equations
* Simultaneous
* Quadratic
	+ Linear graphs
* Plotting
* Interpretation
	+ Applications of linear graphs
* Curves of first and second degree
* Plotting
* Interpretation
* Applications
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Use trigonometry to solve practical work problems
 | * Meaning of trigonometry
* Pythagoras theorem
* Trigonometry ratios of angles
* Trigonometric identities
* Conversion of angles
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 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
 |
| 1. Apply matrices in work
 | * + Meaning of matrix
	+ Types of matrices
	+ Matrix operations
* Compatibility
* Addition
* Subtraction
* Multiplication
	+ Determination of inverse of a matrix
	+ Solution of simultaneous equations with two and three unknowns
	+ Applications of matrices
 | * Assignments
* Supervised exercises
* Written tests
 |
| 1. Collect, organize and interpret statistical data
 | * + Classification of data
* Grouped data
* Ungrouped data
	+ Data collection
* Importance of sampling
* Errors in sampling
* Types of sampling and their limitations
	+ Tabulation of data
* Class intervals
* Class boundaries
* Frequency tables
* Cumulative frequency
	+ Diagrammatic and graphical presentation of data e.g.
* Histograms
* Frequency polygons
* Bar charts
* Pie charts
	+ Cumulative frequency curves
	+ Meaning of measures of central tendency
	+ Measures
* Properties
* Calculation and interpretation of mean, mode and median
	+ Variance and standard deviation
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 1. Apply vectors in work
 | * + Meaning of vector
	+ Representations of vectors
	+ Operations of vectors
* Addition
* Subtraction
* Scalar and vector products
	+ Determination of angles
 | * Assignments
* 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
* Ven diagrams
 | * Written tests
* Assignments
* Supervised exercises
 |
| 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
 |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

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

## MECHANICAL SCIENCE PRINCIPLES

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Apply Mechanical science principles**

**Duration of Unit**: 60 hours

**Unit Description**

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

**Summary of Learning Outcomes**

1. Use the concept of mechanical science
2. Determine effects of loading in static and dynamic engineering systems
3. Analyse properties of materials
4. Determine parameters of a fluid system
5. Use of basic mechanical systems in power transfer

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Use the concept of mechanical science
 | * Define work, force, mechanical advantage and efficiency
* State and explain newton’s laws of motion
* Calculation velocity, distance, and acceleration
* Conversion and SI units of energy, power and work
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Determine effects of loading in static and dynamic engineering systems
 | * Explain type of forces
* Discussion and analysis of reaction of forces
* Calculation of coefficient of friction and inclined plane
* Resolve the forces
* Calculate the resultant force and equilibrium
* Discuss the application of different forces
* Calculation of moments of a force,
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Analyse properties of materials
 | * Definition of mechanical properties of materials
* Draw the stress strain graph
* Discuss application of material depending on their properties
* Discuss effect of environmental factors on material properties.
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 1. Determine parameters of a fluid system
 | * Discussion of Pascal’s principles
* Measuring fluid parameters
* State the laws of gases
* Discuss properties of water and steam
 | * Assignments
* Oral questioning
* Practical tests
* Observation
* Supervised exercises
* Written tests
 |
| 1. Use of basic mechanical systems in power transfer
 | * + Uses and working principle of Gear trains
	+ Uses and working principles of Pulley system, hoists and lifts
	+ Uses and working principles of screws
 | * Assignments
* Supervised exercises
* Written tests
* Practical test
 |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

THERMODYNAMICS PRINCIPLES

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Apply thermodynamics principles**

**Duration of Unit:** 70 hours

**Unit description**

This unit describes the competencies required by a Plant technician in order to apply thermodynamics principles in their work. It includes understanding fundamentals of thermodynamics, understanding compressed air cycles, understanding steam cycles, understanding steam engines, performing refrigeration, understand steam turbines

**Summary of Learning Outcomes**

1. Understand fundamentals of thermodynamics
2. Understand compressed air cycles
3. Understand steam cycles
4. Understand steam engines
5. Perform refrigeration
6. Understand 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. Understand compressed air cycles
 | * + Operation principles of air compressors
* Air processes
	+ Types of air compressors
* Reciprocating compressors.
* Ionic liquid piston compressor.
* Rotary screw compressors.
* Rotary vane compressors.
* Rolling piston.
* Scroll compressors.
* Diaphragm compressors.
* Air bubble compressor.
	+ Calculations in air compressors
* work inputs
* compressor clearances
* varying outputs
* Performing multi-staging and intercooling of air compressors
* Types compressed air engines
* Single cylinder piston type
* Double crank link type
* Characteristics of two types of compressed air engines
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Understand steam cycles
 | * + The Rankine
* Cycle components
* Component efficiencies
* Cycle efficiency
* Engine efficiency
* Factors affecting efficiency – line loss
* Throttling
* Condenser pressure and temperature
	+ Reheat cycle
* Regenerative cycle
* Bleed cycle
* Combination cycle
* Cycle analysis
	+ Stream generation
* Types of boilers
* Feed water considerations
* Fuel and combustion principles
* Boiler efficiencies
	+ Steam cycle efficiencies
* Deviations from ideal
* Line losses
* Throttling heat losses
* Condensate temperatures
* Feed and air pre-heating
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 1. Understand steam engines
 | * + Determining reciprocating engine principles
	+ Determining valves and timing methods
* Indictor diagrams
	+ Power calculations
* Effect of cut-off
* Back pressure
* Condensing and non-condensing
* Staging
* Single acting
* Double acting
* Referred pressures
	+ Calculation of ideal thermal and mechanical efficiency
* Determining of indicated and brake power
 | * Assignments
* Oral questioning
* Practical
* Supervised exercises
* Written tests
 |
| 1. Understand steam turbines
 | * + Determining Reaction and impulse
	+ Performing staging of steam turbines
	+ Performing velocity calculations
	+ Determining the turbine design considerations
	+ Calculation of ideal, thermal and mechanical efficiencies
	+ Determining factors affecting efficiencies
* Performing condensing arrangements of steam turbines
 | * Assignments
* Oral questioning
* Practical tests
* Observation
* Supervised exercises
 |
| 1. Perform refrigeration
 | * + Determining the Carnot cycle
* Vapour compression cycle
* Coefficient of performance
	+ Performing cycle analysis
* Plant output calculation
* Factors affecting efficiency
* Compression procedures
* Intercooling
* Sub-cooling
* Cascade staging
	+ Studying heat pumps
* Coefficient of performance heating
* Coefficient of performance cooling
	+ Determining absorption refrigeration systems
	+ Determination of steam jet refrigeration systems
 | * Assignments
* Oral questioning
* 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

FLUID MECHANICS PRINCIPLES

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

**Relationship to Occupational Standards**

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

**Duration of Unit:** 40 hours

**Unit description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Understand flow of fluids
 | * Flow rate in pipes
* Losses in pipes
* Causes of losses in pipes
* Application of flow loss equations
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Demonstrate knowledge in viscous flow
 | * Viscous flow between parallel surfaces
* Viscous flow equations
* Application of viscous flow equations
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Perform dimensional analysis
 | * + Dimensional analysis definition
	+ Principle of dimensional homogeneity
	+ Fundamental dimensions and units
	+ Physical quantities
* Application of dimensional analysis
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 1. Operate fluid pumps
 | * + Principle of operation of pumps
	+ Reciprocating pump equation
	+ Centrifugal pump equation
	+ Application of pump equations 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

# CORE UNITS OF LEARNING

## INSTALLATION\* OF MECHANICAL PLANT MACHINERY

\* **in DACUM chart and OS, the title is INSTALL, consider revision.**

**UNIT CODE:** ENG/CU/MPE/CR/01/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Install mechanical plant machinery**

**Duration of Unit:** 80 hours

**Unit description**

This unit covers the competencies required to install mechanical plant machineries. It involves competencies to observe occupational health and safety, obtain and utilize technical drawing, obtain work permit for authorization, prepare for installation, participate in installation of plant machine, test and commission machine where applicable.

**Summary of Learning Outcomes**

1. Observe occupational health and safety
2. Obtain and utilize technical drawing
3. Obtain work permit for authorization
4. Prepare for installation
5. Install plant machine
6. Test and commission machine where applicable.

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Observe occupational health and safety
 | * Safety
* Personal protective equipment
* Tools Usage, storage and maintenance.
* Work place planning and housekeeping.
* Safety induction and signs placement.
* Adherence
 | * Practical
* Observation
* Written
* Oral
 |
| 1. Obtain and utilize technical drawing
 | * Identification of technical drawings.
* Interpretation of technical drawings.
* Production of operation plans.
* Drawing using (CAD)
* Basic drawing using instruments.
 | * Observation
* Written
* Oral
* Practical
 |
| 1. Obtain work permit for authorization
 | * + Preparation and Presentation of application documents.
	+ Certification of application documents.
	+ Payment for Application.
	+ Presentation of certified copies
	+ Obtaining work permit.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Prepare for installation
 | * Identification of system requirements.
* Materials
* Suppliers
* Checking of correct installation parameters.
* Dimensions.
* Levels.
* Reporting of non-compliance.
* Alteration/correction based on approval.
* Preparation of surfaces, materials and components.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Install plant machine where applicable\*

NOTE: remove highlighted statement | * Safety
* Tools and equipment selection.
* Analysis of installation manuals.
* Utilization of documented installation procedures.
* Installation, positioning and securing of machine.
* Securing of machine accessories.
* Checking of installation and re-adjustments.
* Waste disposal.
* Installation documentation
 | • Practical• Oral• Observation• Written |
| 1. Test and commission machine under supervision
 | * Safety
* Identification of testing tools and equipment.
* Machine testing according to functionality.
 | • Practical• Oral• Observation• Written |

**Suggested Methods of Delivery**

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

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

* Visiting lecturer/trainer from the Plants service and repair sector;
* Industrial visits.

|  |
| --- |
| **Recommended Resources** **Tools, Equipment, Materials and supplies*** Workshop (electrical / mechanical / hydraulic)
* Cutting machines
* Bending machines
* Vices
* Hand tool
* Powers tools
* Fasteners
* Welding machines
* Testing machines
* Mechanical tool box
* Sheet metal
* Stationery
* Calibration machines
 |
| **Reference materials**Manufacturers service manuals for all the modulesPlant Engineering text books. |

**PERFORM PLANT MAINTENANCE**

**UNIT CODE:** ENG/CU/MPE/CR/02/5/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. It involves competencies to inspect production plant, identify maintenance needs, Conduct breakdown maintenance, Conduct preventive maintenance, Conduct corrective maintenance, Test and commission where applicable.

**Summary of Learning Outcomes**

1. Inspect production plant
2. Identify maintenance needs
3. Conduct breakdown maintenance
4. Conduct preventive maintenance
5. Conduct corrective maintenance
6. Test and commission where applicable

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Inspect production plant
 | * Safety
* Developing inspection checklist and adherence.
* Inspection equipment selection.
* Identification and confirmation of inspection checks.
* Carrying out required inspections.
* Defects identification and rectification.
* Inspection Documentation.
 | * Practical
* Observation
* Written
* Oral
 |
| 1. Identify maintenance needs
 | * + Types of maintenance
* Preventive
* Routine
* Breakdown
* Predictive
	+ Adherence to work safety

omit as it’s not necessary for this learning outcome | * Observation
* Written
* Oral
* Practical
 |
| 1. Conduct breakdown maintenance
 | * + Machine inspection.
	+ Identifying, dismantling and marking of faulty assemblies.
	+ Servicing and assembly of machine components.
	+ Machine testing
	+ Documentation and commissioning
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Conduct preventive maintenance
 | * + Prepare machine for maintenance.
* Cleaning
* Tagging
	+ Preventive maintenance procedure
* Cleaning
* Lubrication
* Re-painting
* Repair
	+ Reporting of maintenance challenges.
	+ Checking machine functionality against operational parameters.
	+ Waste disposal.
	+ Documentation
 | • Practical• Oral• Observation• Written |
| 1. Conduct corrective maintenance
 | * + Machine inspection.
	+ Fault diagnosis and identification.
	+ Perform corrective maintenance on faulty components.
	+ Waste disposal.
	+ Documentation
 | • Practical• Oral• Observation• Written |
| 1. Test and commission where applicable
 | * + Identification of testing tools and equipment
	+ Testing and rectification of machine.
	+ Calibration and adjustments.
	+ Documentation
 |  |

**Suggested Methods of Delivery**

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

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

* Visiting lecturer/trainer from the Plants service and repair sector;
* Industrial visits.

**Recommended Resources**

|  |
| --- |
| **Tools, Equipment, Materials and supplies*** Workshop (electrical / mechanical / hydraulic)
* Cutting machines
* Bending machines
* Vices
* Hand tool
* Powers tools
* Fasteners
* Welding machines
* Testing machines
* Mechanical tool box
* Sheet metal
* Stationery
* Calibration machines
 |
| **Reference materials**Manufacturers service manuals for all the modulesPlant Engineering text books. |

## MAINTAIN HYDRAULIC AND PNEUMATIC SYSTEMS

**UNIT CODE:** ENG/CU/MPE/CR/03/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Maintain Hydraulic and Pneumatic Systems**

**Duration of Unit:** 70hours

**Unit description**

This unit covers the competencies required to perform plant maintenance. It involves competencies to observe occupational health and safety, Repair hydraulic and pneumatic systems, Test and commission hydraulic and pneumatic systems where applicable.

**Summary of Learning Outcomes**

1. Observe occupational health and safety
2. Repair hydraulic and pneumatic systems
3. Test and commission hydraulic and pneumatic systems where applicable

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Observe occupational health and safety
 | * + Safety
* PPES (Personal protective equipment.
* Tools and equipment storage, maintenance and usage.
* Safety signs.
	+ Workspace housekeeping, planning and maintenance.
 | * Practical
* Observation
* Written
* Oral
 |
| 1. Repair hydraulic and pneumatic systems where applicable
 | * + Analysis of service manuals
	+ Selection of tools and equipment.
	+ System locking before operation.
* Electrical power isolation
* Tagging
	+ Repairing of components.
	+ Inspection of oil validity and leakages.
	+ Rectification of Defects.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Test and commission hydraulic and pneumatic systems where applicable
 | * + Verification of Peripheral devices for proper connection and functionality.
	+ Check for fluid flow, leakages and oil validity.
	+ Selection and operation of testing equipment.
	+ Testing of Instruments and controllers.
 | • Practical• Oral• Observation• Written |

**Suggested Methods of Delivery**

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

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

* Visiting lecturer/trainer from the Plants service and repair sector;
* Industrial visits.

**Recommended Resources**

|  |
| --- |
| **Tools, Equipment, Materials and supplies*** Workshop (electrical / mechanical / hydraulic)
* Cutting machines
* Bending machines
* Vices
* Hand tool
* Powers tools
* Fasteners
* Welding machines
* Testing machines
* Mechanical tool box
* Sheet metal
* Stationery
* Calibration machines
* Valves
* Actuators
* Hydraulic pumps/Air compressors
* Pipes
* Connectors
* Steel rule
* Tape measure

NOTE; Also include measuring tools;  |
| **Reference materials**Manufacturers service manuals for all the modulesMechanical plant engineering text books |

## OPERATION OF PLANT MACHINES/UTILITIES

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Operate plant machines/utilities**

**Duration of Unit:** 70 hours

**Unit description**

This unit covers the competencies required to perform plant maintenance. It involves competencies to observe occupational health and safety, handle raw materials, Set machine parameters, Operate plant machine, Control product quality, Carry out autonomous maintenance, Record production data and Store finished products.

**Summary of Learning Outcomes**

* 1. Observe occupational health and safety
	2. Handle raw materials
	3. Set machine parameters
	4. Operate plant machine
	5. Control product quality
	6. Carry out autonomous maintenance
	7. Record production data
	8. Store finished products.

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Observe occupational health and safety
 | * + Safety
* PPES (Personal protective equipment.
* Tools and equipment storage, maintenance and usage.
* Safety signs.
* Removal of unwanted materials from raw material.
	+ Workspace housekeeping, planning and maintenance.
 | * Practical
* Observation
* Written
* Oral
 |
| 1. Handle raw materials
 | * + Requisition of raw materials.
	+ Storage of raw materials.
	+ Inspection of material handling equipment.
	+ Operation of material handling machinery.
	+ Cautious handling of hazardous materials.
 | * Observation
* Written
* Oral
* Practical
 |
| 1. Set machine parameters
 | * + Establishing of machine safety functions.
	+ Identification of finished products and raw materials.
	+ Setting of machine parameters.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate plant machine
 | * + Adherence to work safety.
	+ Visual inspection of plant machinery.
	+ Machine operation
* Switch **ON** machine
* Observe running of machine
* Let links, joints and protruding parts go to their resting position\*.

\*revise statement* Switch off.
	+ Operate lifting equipment as per manual.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Control product quality
 | * + Production manual analysis
	+ Setting of production parameters.
	+ Production of products and inspecting against set parameters.
	+ Isolation of defective products.
 | • Practical• Oral• Observation• Written |
| 1. Carry out autonomous maintenance
 | * Adherence to work safety
* Obtaining of spare Approval.
* Carry out autonomous maintenance
* Carry out Overall Equipment Effectiveness(OEE)
* Performance
* Availability
* Quality
* Implementation of improved working practices
 | • Practical• Oral• Observation• Written |
| 1. Record production data
 | * Identification of information and data to be recorded.
* Methods of data recording.
* Optical mark recognition.
* Bar codes
* Recording of data and information.
* Report Development as per production procedures.
* Report writing skills.
* Production documents filing.
* Spring files
* Computers
* Log books
 |  |
| 1. Store finished products.
 | * Recording of finished products.
* Cleanliness of the storage section.
* Specialized storage of finished products.
* Storage of other materials and by-products.
* Filing
* Assessment
 |  |

**Suggested Methods of Delivery**

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

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

* Visiting lecturer/trainer from the Plants service and repair sector;
* Industrial visits.

**Recommended Resources**

|  |
| --- |
| **Tools, Equipment, Materials and supplies*** Workshop (electrical / mechanical / hydraulics
* Hand tool
* Testing machines.
* Mechanical tool box.
* Stationery
* Calibration machines
* Protective gear
* Lifting equipment
* Storage facility.
 |
| **Reference materials**Manufacturers service manuals for all the modulesPlant engineering text books |

##

##  MANAGE SPARES AND CONSUMABLES INVENTORY

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Manage spares and consumables inventory**

**Duration of Unit:** 40 hours

**Unit description**

This unit describes the competencies required by a technician to manage spares and consumables inventory. It involves competencies to observe occupational health and safety, store received spares/consumables, carry out stock taking and record inventory items.

**Summary of Learning Outcomes**

1. Observe occupational health and safety
2. Store received spares/consumables
3. Issue spares and consumables
4. Carry out stock taking
5. Record inventory items.

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

|  |  |  |
| --- | --- | --- |
| Learning Outcome | **Content** | **Suggested Assessment Methods** |
| 1. Observe occupational health and safety
 | * + Safety
	+ Personal protective equipment(PPES)
	+ Fire fighting
	+ Safety signage
	+ First aid
	+ Work place housekeeping.
	+ Recording of accidents and incidents.
	+ Tools and equipment
	+ Storage
	+ Usage
	+ Maintenance
 | * Practical
* Observation
* Written
* Oral
 |
| 1. Store received spares/consumables
 | * + Labelling and tagging of received spares and consumables.
	+ Generation of Bin cards.
	+ Raising of Goods received note.
	+ Cleaning of storage location.
	+ Recording of products.
	+ Maintenance of storage conditions.
	+ Storage of hazardous and fragile products.
	+ Storage of other materials and finished products.
	+ Adherence to safety standards.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Issue spares and consumables
 | * + Obtain/receiving requisition from the user.
	+ Identification of Spare/consumable as per store setup.
	+ Issuance of Spare/consumable as per store setup
	+ Recording and updating of Records.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Carry out stock taking
 | * + Verification of stock physical quantities.
	+ Checking labelling/tagging information on products.
	+ Recording of stock replenishing requirements
	+ Disposal of damaged spares and consumables.
	+ Updating of stock records.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Record inventory items
 | * + Recording of daily inventory.
	+ Compilation of daily inventory to generate monthly report
 | * Practical
* Oral
* Observation
* Written
 |

**Suggested Methods of Delivery**

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

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

* Visiting lecturer/trainer from the Plants service and repair sector;
* Industrial visits.

|  |
| --- |
| **Recommended** **Tools, Equipment, Materials and supplies*** Workshop (electrical / mechanical / hydraulics
* Hand tool
* Testing machines.
* Mechanical tool box.
* Stationery
* Calibration machines
* Protective gear
* Lifting equipment
* Computers
* White boards
* Printers
* Data collection devices
* Calculators
* Storage facility.
 |
| **Reference materials**Manufacturers service manuals for all the modulesPlant engineering text booksManagement reference materials |

## WORKSHOP PROCESSES

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency:  **Perform workshop processes**

**Duration of Unit:** 60 hours

**Unit description**

This unit describes the competencies required by a technician to perform workshop processes. It involves competencies toobserve occupational safety, perform sheet metal works, carry out metal joining processes, operate lathe machines, perform mechanical bench works, operate milling machines, operate grinding machine, operate hand tools, operate drilling machine and perform foundry works.

**Summary of Learning Outcomes**

1. Observe occupational safety
2. Perform sheet metal works
3. Carry out metal joining processes
4. Operate lathe machines
5. Perform mechanical bench works
6. Operate milling machines
7. Operate grinding machine
8. Use hand tools
9. Operate hydraulic press
10. Operate shaper machine
11. Operate power hacksaw
12. Operate drilling machine
13. Perform foundry works

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

|  |  |  |
| --- | --- | --- |
| Learning Outcome | **Content** | **Suggested Assessment Methods** |
| 1. Observe occupational safety
 | * + Safety
	+ Personal protective equipment(PPES)
	+ Fire fighting
	+ Safety signage
	+ First aid
	+ Work place housekeeping.
	+ Recording of accidents and incidents.
	+ Tools and equipment
	+ Storage
	+ Usage
	+ Maintenance
 | * Practical
* Observation
* Written
* Oral
 |
| 1. Perform sheet metal works
 | * + Observe safety
	+ Interpretation of technical drawings.
	+ Selection of tools and equipment.
	+ Marking and cutting of work pieces.
	+ Folding procedures
* Bending
* Rolling
	+ Inspection of Products.
 | * Observation
* Written
* Oral
* Practical
 |
| 1. Carry out metal joining processes
 | * + Observe safety
	+ Preparation of surfaces.
	+ Parts joining methods.
	+ Riveting
	+ Welding
	+ Bolting
	+ Seaming
	+ Screwing
	+ Adhesives
	+ Finishing processes.
* Polishing & buffing
* Grinding
* Honing
* Lapping
* Painting
	+ Inspection of joints
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate lathe machines
 | * + Observe safety
	+ Interpretation of Technical drawings.
	+ Selection and preparation of cutting tools.
	+ Mounting of work piece on the lathe machine.
	+ Setting of the lathe machine for operation.
	+ Production.
	+ Inspection of products
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Perform mechanical bench works
 | * + Observe safety
	+ Interpretation of Technical drawings.
	+ Marking out
	+ Mounting and setting of work piece.
	+ Tools and equipment selection.
	+ Production.
	+ Inspection of products
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate milling machines
 | * + Observe safety
	+ Interpretation of Technical drawings
	+ Mounting and setting of work piece
	+ Selection of cutting tools.
	+ Setting of machine parameters.
	+ Parts Production
	+ Inspection of products
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate grinding machine
 | * + Observe safety
	+ Interpretation of Technical drawings
	+ Mounting and setting of work piece
	+ Selection of grinding wheel.
	+ Parts production
	+ Inspection of products
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Use hand tools
 | * + Observe safety
	+ Selection of hand tools.
	+ Inspection of hand tools.
	+ Utilization, cleaning and storage of hand tools.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate hydraulic press
 | Observe safety* 1. Obtaining work instructions.
	2. Operation of hydraulic press.
* Mounting of work piece
* Setting machine parameters.
* Operating of hydraulic press.
* Switching off.

Omit the numbering, adopt the bullets as for other P.Cs | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate shaper machine
 | * + Observe safety
	+ Interpretation of Technical drawings
	+ Mounting and setting of work piece
	+ Selection of cutting tools.
	+ Production
	+ Inspection of products
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate power hacksaw
 | * + Observe safety
	+ Checking of blade condition.
	+ Mounting of work piece
	+ Machine operation.
	+ Lubrication.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate drilling machine
 | * + Observe safety
	+ Interpretation of Technical drawings.
	+ Selection and preparation of drilling tools.
	+ Mounting of work piece on the drill machine.
	+ Setting of drilling machine for operation.
	+ Production.
	+ Inspection of products
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Perform foundry works
 | * + Observe safety
	+ Interpretation of Technical drawings
	+ Inspection of moulds.
	+ Inspection of furnace.
	+ Inspection of raw materials.
	+ Casting procedures
	+ Cleaning and inspection of cast metal.
	+ Conducting finishing processes.
	+ Waste disposal.
 | * Practical
* Oral
* Observation
* Written
 |

**Suggested Methods of Delivery**

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

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

* Visiting lecturer/trainer from the Plants service and repair sector;
* Industrial visits.

|  |
| --- |
| **Recommended** **Tools, Equipment, Materials and supplies*** Workshop (electrical / mechanical / hydraulics
* Hand tool
* Testing machines.
* Mechanical tool box.
* Stationery
* Protective gear
* Lifting equipment
* Printers
* Computers
* Data collection devices
* Calculators
* Storage facility.
* Furnace
* Sand
* Moulds
* Refractory bricks.
* Fuel
* Grinder
* Scrap metal
* Lighting devices.
* Tongs.
 |
| **Reference materials**Manufacturers service manuals for all the modulesPlant engineering text books |

##