

**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)**

**COMPETENCY BASED CURRICULUM**

**FOR**

**MECHANICAL PLANT ENGINEERING**

**LEVEL 6**



TVET CDACC

P.O BOX 15745-00100

NAIROBI

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# FOREWORD

The provision of quality education and training is fundamental to the Government’s overall strategy for social economic development. Quality education and training will contribute to achievement 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 plant 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 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 Plant Engineering Sector Skills Advisory Committee (SSAC) and other stakeholders have developed this curriculum.

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, Mechanical 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 Plant Engineering sector will 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

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/ 6/A**

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

Control version

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# COURSE DESCRIPTION

|  |
| --- |
| The Mechanical Plant Technician Level 6 qualification consists of competencies that a person must achieve to enable him/her to workin mechanical plant.It entails designing of production plant, installing of mechanical plant machinery, maintenancing production plant, operating hydraulic and pneumatic systems, operating of plant machines/utilities, optimizing production systems, understanding Kaizen principles and managing spares and consumables inventory |
| **BASIC UNITS OF COMPETENCY** |
| **Unit of Learning Code**  | **Units of Learning Title**  | **Duration in Hours**  | **Credits Factors** |
| **ENG/CU/MPE/BC/01/6/A** | Communication skills | 40 | 4.0 |
| **ENG/CU/MPE/BC/02/6/A** | Digital literacy | 60 | 6.0 |
| **ENG/CU/MPE/BC/03/6/A** | Entrepreneurial skills | 100 | 10.0 |
| **ENG/CU/MPE/BC/04/6/A** | Employability skills | 80 | 8.0 |
| **ENG/CU/MPE/BC/05/6/A** | Environmental literacy | 40 | 4.0 |
| **ENG/CU/MPE/BC/06/6/A** | Occupational health and safety | 40 | 4.0 |
| **TOTAL** | **360** | **36.0** |
| **COMMON UNITS OF COMPETENCY** |
| **ENG/CU/MPE/CC/01/6/A** | Technical drawing | 150 | 15 |
| **ENG/CU/MPE/CC/02/6/A** | Engineering mathematics | 150 | 15 |
| **ENG/CU/MPE/CC/03/6/A** | Mechanical science principles | 75 | 7.5 |
| **ENG/CU/MPE/CC/04/6/A** | Material science and metallurgy  | 70 | 7.0 |
| **ENG/CU/MPE/CC/05/6/A** | Thermodynamics principles | 40 | 4.0 |
| **ENG/CU/MPE/CC/06/6/A** | Fluid mechanics principles | 75 | 7.5 |
| **TOTAL** | **560** | **56.0** |
| **CORE UNITS OF COMPETENCY** |
| **ENG/CU/MPE/CR/01/6/A** | Designing of production plant | 120 | 12.0 |
| **ENG/CU/MPE/CR/02/6/A** | Installation of mechanical plant machinery | 180 | 18.0 |
| **ENG/CU/MPE/CR/03/6/A** | Production plant maintenance | 160 | 16.0 |
| **ENG/CU/MPE/CR/04/6/A** | Hydraulic and pneumatic systems | 150 | 15.0 |
| **ENG/CU/MPE/CR/05/6/A** | Operation of plant machines/utilities | 140 | 14.0 |
| **ENG/CU/MPE/CR/06/6/A** | Optimization of production systems | 130 | 13.0 |
| **ENG/CU/MPE/CR/07/6/A** | Kaizen principles | 100 | 10.0 |
| **ENG/CU/MPE/CR/08/6/A** | Manage spares and consumables inventory | 120 | 12.0 |
| **ENG/CU/MPE/CR/09/6/A** | Workshop processes | 200 | 20.0 |
| **ENG/CU/MPE/CR/10/6/A** | Production plant management | 100 | 10.0 |
|  | Industrial attachment | 480 | 48.0 |
| **TOTAL**  | **1880** | **188.0** |
| **GRAND TOTAL** | **2880** | **288.0** |

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

The total duration of the course is 2880 hours

1. **Entry Requirements**

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

1. Kenya Certificate of Secondary Education (K.C.S.E.) with a minimum mean grade of C- (C minus)

**Or**

1. 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)
2. **Industrial attachment**

An individual enrolled in this course will be required to undergo an industrial attachment in a firm dealing with Mechanical plant engineering 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 Engineering 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/MPE/BC/01/6/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate communication skills

**Duration of Unit:** 40 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. Meet communication needs of clients and colleagues
2. Develop communication strategies
3. Establish and maintain communication pathways
4. Promote use of communication strategies
5. Conduct interview
6. Facilitate group discussion
7. Represent the organization

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Meet communication needs of clients and colleagues
 | * Communication process
* Modes of communication
* Medium of communication
* Effective communication
* Barriers to communication
* Flow of communication
* Sources of information
* Organizational policies
* Organization requirements for written and electronic communication methods
* Report writing
* Effective questioning techniques (clarifying and probing)
* Workplace etiquette
* Ethical work practices in handling communication
* Active listening
* Feedback
* Interpretation
* Flexibility in communication
* Types of communication strategies
* Elements of communication strategy
 | * Interview
* Written
 |
| 1. Develop communication strategies
 | * Dynamics of groups
* Styles of group leadership
* Openness and flexibility in communication
* Communication skills relevant to client groups
 | * Interview
* Written
 |
| 1. Establish and maintain communication pathways
 | * Types of communication pathways
 | * Interview
* Written
 |
| 1. Promote use of communication strategies
 | * Application of elements of communication strategies
* Effective communication techniques
 | * Interview
* Written
 |
| 1. Conduct interview
 | * Types of interview
* Establishing rapport
* Facilitating resolution of issues
* Developing action plans
 | * Interview
* Written
 |
| 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
 | * Interview
* Written
 |
| 1. Represent the organization
 | * Presentation techniques
* Development of a presentation
* Multi-media utilization in presentation
* Communication skills relevant to client groups
 | * Interview
* Written
 |

**Suggested Delivery Methods**

* Discussion
* Role playing
* Simulation
* Direct instruction
* Practice by trainee

**Recommended Resources**

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

**DIGITAL LITERACY**

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

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate digital literacy

**Duration of Unit:** 60 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

**ENTREPRENEURSHIP EDUCATION**

**UNIT CODE: ENG/CU/MPE/BC/03/6/A**

**Relationship to occupational standards**

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

**Duration of unit:** 100 hours

**Unit Description**

This unit covers the competencies required to demonstrate understanding of entrepreneurship. It involves demonstrating understanding of an entrepreneur, entrepreneurship and self-employment. It also involves identifying entrepreneurship opportunities, creating entrepreneurial awareness, applying entrepreneurial motivation and developing business innovative strategies.

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Demonstrate knowledge of entrepreneurship and self-employment
 | * Importance of self-employment
* Requirements for entry into self-employment
* Role of an Entrepreneur in business
* Contributions of Entrepreneurs to National development
* Entrepreneurship culture in Kenya
* Born or made entrepreneurs
 | * Observation
* Case studies
* Individual/group assignments
* Projects
* Written tests

Oral questionsThird party reportInterviews |
| 1. Identify entrepreneurship opportunities
 | * Business ideas and opportunities
* Sources of business ideas
* Business life cycle
* Legal aspects of business
* Assessment of product demand
* Business environment
* Factors to consider when evaluating business environment
* Technology in business
 | * Observation
* Case studies
* Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Create entrepreneurial awareness
 | * Forms of businesses
* Sources of business finance
* Factors in selecting source of business finance
* Governing policies on Small Scale Enterprises (SSEs)
* Problems of starting and operating SSEs
 | * Observation
* Case studies
* Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Apply entrepreneurial motivation
 | * Internal and external motivation
* Motivational theories
* Self-assessment
* Entrepreneurial orientation
* Effective communications in entrepreneurship
* Principles of communication
* Entrepreneurial motivation
 | * Observation
* Case studies
* Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Develop business innovative strategies
 | * Innovation in business
* Small business Strategic Plan
* Creativity in business development
* Linkages with other entrepreneurs
* ICT in business growth and development
 | * Observation
* Case studies
* Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Develop Business Plan
 | * Business description
* Marketing plan
* Organizational/Management
* plan
* Production/operation plan
* Financial plan
* Executive summary
* Presentation of Business Plan
 | * Observation
* Case studies
* Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |

**Suggested Methods of instruction:**

* Direct instruction
* Project
* Case studies
* Field trips
* Discussions
* Demonstration
* Question and answer
* Problem solving
* Experiential
* Internship
* Team training
* Guest speakers

**Recommended Resources**

* Case studies
* Business plan templates
* Computers
* Overhead projectors
* Internet
* Mobile phone
* Video clips
* Films
* Newspapers and Handouts
* Business Journals
* Writing materials

**EMPLOYABILITY SKILLS**

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

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate employability skills

**Duration of Unit:** 80 hours

**Unit Description**

This unit covers competencies required to demonstrate employability skills. It involves conducting self-management, demonstrating interpersonal communication, critical safe work habits, leading a workplace team, planning and organizing work, maintaining professional growth and development, demonstrating workplace learning, problem solving skills and managing ethical performance.

**Summary of Learning Outcomes**

1. Conduct self-management
2. Demonstrate interpersonal communication
3. Demonstrate critical safe work habits
4. Lead a workplace team
5. Plan and organize work
6. Maintain professional growth and development
7. Demonstrate workplace learning
8. Demonstrate problem solving skills
9. Manage ethical performance

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Conduct self-management
 | * Self-awareness
* Formulating personal vision, mission and goals
* Strategies for overcoming life challenges
* Managing emotions
* Emotional intelligence
* Assertiveness versus aggressiveness
* Expressing personal thoughts, feelings and beliefs
* Developing and maintaining high self-esteem
* Developing and maintaining positive self-image
* Setting performance targets
* Monitoring and evaluating performance
* Articulating ideas and aspirations
* Accountability and responsibility
* Good work habits
* Self-awareness
* Values and beliefs
* Self-development
* Financial literacy
* Healthy lifestyle practices
* Adopting safety practices
 | * Observation
* Written
* Oral interview
* Third party report
 |
| 1. Demonstrate interpersonal communication
 | * Meaning of interpersonal communication
* Listening skills
* Types of audience
* Public speaking
* Writing skills
* Negotiation skills
* Reading skills
* Meaning of empathy
* Understanding customers’ needs
* Establishing communication networks
* Assertiveness
* Sharing information
 | * Observation
* Written
* Oral interview
* Third party report
 |
| 1. Demonstrate critical safe work habits
 | * Stress and stress management
* Time concept
* Punctuality and time consciousness
* Leisure
* Integratingpersonal objectives into organizational objectives
* Resources mobilization
* Resources utilization
* Setting work priorities
* Developing healthy relationships
* HIV and AIDS
* Drug and substance abuse
* Managing emerging issues
 | * Observation
* Written
* Oral interview
* Third party report
 |
| 1. Lead a workplace team
 | * Leadership qualities
* Power and authority
* Team building
* Determination of team roles and objectives
* Team parameters and relationships
* Individual responsibilities in a team
* Forms of communication
* Complementing team activities
* Gender and gender mainstreaming
* Human rights
* Developing healthy relationships
* Maintaining relationships
* Conflicts and conflict resolution
* Coaching and mentoring skills
 | * Observation
* Oral interview
* Written
* Third party report
 |
| 1. Plan and organize work
 | * Functions of management
* Planning
* Organizing
* Time management
* Decision making concept
* Task allocation
* Developing work plans
* Developing work goals/objectives and deliverables
* Monitoring work activities
* Evaluating work activities
* Resource mobilization
* Resource allocation
* Resource utilization
* Proactive planning
* Risk evaluation
* Problem solving
* Collecting, analysing and organising information
* Negotiation
 | * Observation
* Oral interview
* Written
* Third party report
 |
| 1. Maintain professional growth and development
 | * 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 workplace learning
 | * Managing own learning
* Mentoring
* Coaching
* Contributing to the learning community at the workplace
* Cultural aspects of work
* 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
* Managing emerging issues
* Future trends and concerns in learning
 | * Observation
* Oral interview
* Written
* Third party report
 |
| 1. Demonstrate problem solving skills
 | * Critical thinking process
* Data analysis tools
* Decision making
* Creative thinking
* Development of creative, innovative and practical solutions
* Independence in identifying and solving problems
* Solving problems in teams
* Application of problem-solving strategies
* Testing assumptions
* Resolving customer concerns
 | * Observation
* Oral interview
* Written
* Third party report
 |
| 1. Manage ethical performance
 | * Meaning of ethics
* Ethical perspectives
* Principles of ethics
* Ethical standards
* Organization code of ethics
* Common ethical dilemmas
* Organization culture
* Corruption, bribery and conflict of interest
* Privacy and data protection
* Diversity, harassment and mutual respect
* Financial responsibility/accountability
* Etiquette
* Personal and professional integrity
* Commitment to jurisdictional laws
* Emerging issues in ethics
 | * Observation
* Oral interview
* Written
* Third party report
 |

**Suggested Methods of Delivery**

* Instructor lead facilitation of theory
* Demonstrations
* Simulation/Role play
* Group Discussion
* Presentations
* 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/05/6/A**

**Relationship to Occupational Standards**:

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

**Duration of Unit:** 40 hours

**Unit Description**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** |  **Content** | **Suggested Assessment Methods** |
| 1. Control environmental hazard
 | * Purposes and content of Environmental Management and Coordination Act 1999
* 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/06/6/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 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/01/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit: 150 Hours**

**Unit Description**

This unit covers the competencies required to prepare and interpret technical drawings by a 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/02/6/A

**Relationship to Occupational Standards**

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

Duration of Unit: **60 hours**

**Unit Description**

This unit describes the competencies required by a Plant 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/03/6/A**

**Relationship to Occupational Standards**

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

**Duration of Unit: 75** hours

**Unit Description**

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

**Summary of Learning Outcomes**

1. 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

## MATERIAL SCIENCE AND PERFORM METALLURGICAL PROCESSES

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

**Relationship to Occupational Standards**

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

**Duration of Unit: 75 hours**

**Unit Description:**

The learner will be introduced to performing material testing and metallurgical processes. It involves analysing 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. Analyze 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
	+ Analyzing 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

**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

THERMODYNAMICS PRINCIPLES

**UNIT CODE:** ENG/CU/MPE/CC/05/6/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/06/6/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

## DESIGNING OF PRODUCTION PLANT

**UNIT CODE: ENG/CU/MPE/CR/01/6/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Design production plant**

**Duration of Unit: 120 hours**

**Unit description**

This unit describes the competencies required by a technician to design production plant. It involves competencies required to carry out plant assessment needs, identify plant plan, develop multiple plant models, select plant model, simulate developed plant model, document developed plant design and follow up on design implementation and improvements

**Summary of Learning Outcomes**

1. Carry out plant assessment needs
2. Identify plant plan
3. Develop multiple plant models
4. Select plant model
5. Simulate developed plant model
6. Document developed plant design
7. Follow up on design implementation and improvements

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Carry out plant assessment needs
 | * + Data collection
* Methods of data collection
* Sources of data collection
* Objectives
	+ Data analysis and identification of needs based on SOPs
* Documentation of analysed data
* Adherence to national and international standards
 | * Practical
* Observation
* Written
* Oral
 |
| 1. Identify plant plan
 | * Production layouts
* Line/product
* Block
* Process/functional
* Fixed position
* Combination
* Identification of production output
* Safety
* Local legal requirements
* International legal requirements
* Production plant layouts
 | * Observation
* Written
* Oral
* Practical
 |
| 1. Develop multiple plant models
 | * + Identify plant parameters based on expected output.
	+ Analysis of Plant parameters.
	+ Generation of plant plan ideas.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Select plant model
 | * Methods of model analysis.
* Selection of models based on analysis
* Documentation\*
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Simulate developed plant model
 | * Obtaining Modellingrequirement.
* Design development
* Model simulation/testing
* Data Collection.
* Model redesigning.
 | • Practical• Oral• Observation• Written |
| 1. Document developed plant design
 | * Data Storage and documentation.
* Report Development in model design.
* Report writing skills.
* Development of Operation manual.
* Adherence to national and international standards
 | • Practical• Oral• Observation• Written |
| 1. Follow up on design implementation and improvements
 | * Data collection on design performance
* Data Evaluation.
* Report generation.
* Documentation, Amendments and improvements on design performance.
 | • 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
 |
| **Reference materials**Manufacturers service manuals for all the modulesText books. |

## INSTALLATION OF MECHANICAL PLANT MACHINERY

**UNIT CODE:** ENG/CU/MPE/CR/02/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit: 150 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, install plant machine, test and commission machine and document plant installation

**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
7. Document plant installation

**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
 | * 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
 | * Identification of testing tools and equipment.
* Machine testing according to functionality.
* Machine calibration.
* Training of Operators
* Commissioning.
 | • Practical• Oral• Observation• Written |
| 1. Document plant installation
 | * Report Development as per installation procedures.
* Report writing skills.
* Development of Operation and maintenance manual.
* Documentation of Installation adjustments.
 | • 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 modulesText books. |

##  PRODUCTION PLANT MAINTENANCE

**UNIT CODE:** ENG/CU/MPE/CR/03/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Perform plant maintenance.**

**Duration of Unit: 160 hours**

**Unit description**

This unit covers the competencies required to perform plant maintenance. It involves competencies to inspect production plant, identify maintenance needs, Plan and prepare for plant maintenance, Conduct breakdown maintenance, Conduct preventive maintenance, Conduct corrective maintenance, Train plant operators, Test and commission where applicable and Document maintenance work done

**Summary of Learning Outcomes**

1. Inspect production plant
2. Identify maintenance needs
3. Plan and prepare for plant maintenance
4. Conduct breakdown maintenance
5. Conduct preventive maintenance
6. Conduct corrective maintenance
7. Train plant operators
8. Test and commission where applicable
9. Document maintenance work done

**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.
	+ Analysis of Maintenance manuals.
	+ Identification of components to be maintained.
 | * Observation
* Written
* Oral
* Practical
 |
| 1. Plan and prepare for plant maintenance
 | * + Preview of plant Maintenance history.
	+ Work plan development.
	+ Prioritize maintenance rules.
	+ Tools and equipment
* Identification
* Checking for usability
	+ Consumables, spare parts and materials availability.
	+ Labour availability.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Conduct breakdown maintenance
 | * + Decommissioning of machine.
	+ Machine inspection.
	+ Identifying, dismantling and marking of faulty assemblies.
	+ Servicing and assembly of machine components.
	+ Machine testing
	+ Documentation.
	+ Recommissioning.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Conduct preventive maintenance
 | * + Notification of affected personnel.
	+ Prepare machine for maintenance.
* Cleaning
* Decommission
* Tagging
	+ Availing of technical data.
	+ Preventive maintenance procedure
* Cleaning
* Lubrication
* Re-painting
* Repair
	+ Reporting of maintenance challenges.
	+ Checking machine functionality against operational parameters.
	+ Waste disposal.
	+ Documentation.
	+ Machine hand-over.
 | • Practical• Oral• Observation• Written |
| 1. Conduct corrective maintenance
 | * + Notification of all affected personnel.
	+ Machine inspection.
	+ Availing technical data.
	+ Fault diagnosis and identification.
	+ Perform corrective maintenance on faulty components.
* Machine modifications/re-adjustments.
	+ Waste disposal.
	+ Documentation.
	+ Handing over of Machine.
 | • Practical• Oral• Observation• Written |
| 1. Train plant operators
 | * + Identification of training needs.
	+ Preparation of training materials.
	+ Planning and scheduling of training needs.
	+ Training of operators.
	+ Training follow ups.
 | • Practical• Oral• Observation• Written |
| 1. Test and commission where applicable
 | * + Identification of testing tools and equipment
	+ Testing and rectification of machine.
	+ Calibration and adjustments.
	+ Commissioning.
 |  |
| 1. Document maintenance work done
 | * Report Development as per maintenance procedures.
* Report writing skills.
* Maintenance documents filing.
* Spring files
* Computers
* Log books
 |  |

**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 modulesText books. |

##  HYDRAULIC AND PNEUMATIC SYSTEMS

**UNIT CODE:** ENG/CU/MPE/CR/04/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit: 120 hours**

**Unit description**

This unit covers the competencies required to perform plant maintenance. It involves competencies to observe occupational health and safety, troubleshoot hydraulic and pneumatic systems, Identify and obtain spare parts, Repair hydraulic and pneumatic systems, Test and commission hydraulic and pneumatic systems and Record and generate maintenance report

**Summary of Learning Outcomes**

1. Observe occupational health and safety
2. Troubleshoot hydraulic and pneumatic systems
3. Identify and obtain spare parts
4. Repair hydraulic and pneumatic systems
5. Test and commission hydraulic and pneumatic systems
6. Record and generate maintenance report

**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. Troubleshoot hydraulic and pneumatic systems
 | * + Adherence to work requirements policies
	+ Interpretation of System manual.
	+ Identification of Tools and Equipment.
	+ Identification and classification of system faults.
 | * Observation
* Written
* Oral
* Practical
 |
| 1. Identify and obtain spare parts
 | * + Inspection of system parts.
	+ Analyse system manuals and publications.
	+ Contacting and procurement of spare parts.
	+ Receiving and verification of Spare parts.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Repair hydraulic and pneumatic systems
 | * + 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.
	+ Documentation.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Test and commission hydraulic and pneumatic systems
 | * + 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 |
| 1. Record and generate maintenance report
 | * Report Development as per maintenance procedures.
* Report writing skills.
* Maintenance documents filing.
* Spring files
* Computers
* Log books
 | • 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
 |
| **Reference materials**Manufacturers service manuals for all the modulesMechanical engineering text books |

## OPERATION OF PLANT MACHINES/UTILITIES

**UNIT CODE:** ENG/CU/MPE/CR/05/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit: 140 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 and generate production reports 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 and generate production reports
	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.
* Switch off.
	+ Operate lifting equipment as per manual.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Control product quality
 | * + Analysis of production manual.
	+ 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 and generate production reports
 | * Identification of information and data to be reported.
* 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.
 |  |

**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 |

## OPTIMIZATION OF PRODUCTION SYSTEMS

**UNIT CODE:** ENG/CU/MPE/CR/06/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Optimise production systems**

**Duration of Unit: 130 hours**

**Unit description**

This unit describes the competencies required to optimize production systems. It involves competencies required to identify process/ system for review, collect and analyse system/process data, develop system/process tests or trials, develop system/process improvement solution and record and generate production reports

**Summary of Learning Outcomes**

1. Identify process/ system for review
2. Collect and analyse system/process data.
3. Develop system/process tests or trials.
4. Develop system/process improvement solution
5. Record and generate production reports

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify process/ system for review
 | * + Plant performance review
	+ Identification of data collection methods
	+ Identification of data analysis techniques
 | * Practical
* Observation
* Written
* Oral
 |
| 1. Collect and analyse system/process data.
 | * + Data collection
	+ Data analysis techniques
	+ Determining possible causes of system setbacks
 | * Observation
* Written
* Oral
* Practical
 |
| 1. Develop system/process improvement solution
 | * + Proposing controlled tests and trials
	+ Determination of best proposal
	+ Planning for test execution
	+ Testing and further data collection
	+ Data reviewing.
	+ Further testing from collected data
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Develop system/process improvement solution
 | * + Selection of agreed system improvement proposal.
	+ Preparation for execution of the proposal
	+ Implementation of the proposal
	+ Evaluation of the proposal.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Record and generate production reports
 | * + Identification of data to be collected
	+ Methods of recording information and data
	+ Production data recording
	+ Generation of production reports
	+ Data processing and storage
 | * 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 books |

##  KAIZEN PRINCIPLES

**UNIT CODE:** ENG/CU/MPE/CR/07/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit: 100 hours**

**Unit description**

This unit covers the competencies required to apply kaizen principles. It involves competencies to document current processes, identify and capture critical process, analyse current processes, design new processes, evaluate and select among alternatives, develop business case for action, obtain approval for implementing change, plan for improvement process and maintain competitive advantage through continuous process improvement.

**Summary of Learning Outcomes**

1. Document current processes
2. Identify and capture critical process
3. Analyze current processes
4. Design new processes where applicable
5. Evaluate and select among alternatives
6. Develop business case for action
7. Obtain approval for implementing change
8. Plan for improvement process
9. Maintain competitive advantage through continuous process improvement.

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

|  |  |  |
| --- | --- | --- |
| Learning Outcome | **Content** | **Suggested Assessment Methods** |
| 1. Document current processes
 | * + Identifying and defining production process
	+ Outlining process boundaries
	+ Identifying process inputs and outputs
	+ Documenting process details
 | * Practical
* Observation
* Written
* Oral
 |
| 1. Identify and capture critical process
 | * + Production process stages
	+ Arrangement of production process
	+ Data collection on process stages.
	+ Identification of critical process
 | * Observation
* Written
* Oral
* Practical
 |
| 1. Analyze current processes
 | * + Interviewing of production personnel.
	+ Production of process flowcharts.
	+ Identification of process flow exceptions
	+ Identification of process risks.
	+ Identification of areas of improvement.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Design new processes where applicable
 | * + Re-examining of existing process.
	+ Data collection.
	+ Data analysis.
	+ Generation of multiple processes.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Evaluate and select among alternatives
 | * + Analysing of processes.
	+ Analysing of process parameters.
	+ Selection of best working process design.
	+ Documentation.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Develop business case for action
 | * + Description of design process.
	+ Analysis of costs and benefits based on expectations.
	+ Implementation of design process
	+ Production of process design summary.
 |  |
| 1. Obtain approval for implementing change
 | * + Presentation of business case to the management.
	+ Incorporating management proposals.
	+ Re-presentation of business case to management.
	+ Approval for implementation.
 |  |
| 1. Plan for improvement process
 | * + Procurement of materials.
	+ Availing of tools and equipment.
	+ Implementation of process improvements.
	+ Testing and commissioning of new processes.
	+ Documentation.
 |  |
| 1. Maintain competitive advantage through continuous process improvement.
 | * + Determination and calculation of measures of performance.
	+ Calculation of optimum resources.
	+ Identification and use of key performance indicators
 |  |

**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 books |

##  MANAGE SPARES AND CONSUMABLES INVENTORY

**UNIT CODE:** ENG/CU/MPE/CR/08/6/A

**Relationship to Occupational Standards**

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

**Duration of Unit: 80 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, identify critical spares and consumables, procure spares and consumables, inspect ordered spares and consumables, store received spares/consumables, carry out stock taking, manage store human resource and record and generate inventory report

**Summary of Learning Outcomes**

1. Observe occupational health and safety
2. Identify critical spares and consumables
3. Purchase requisition for spares and consumables
4. Inspect ordered spares and consumables
5. Store received spares/consumables
6. Issue spares and consumables
7. Carry out stock taking
8. Manage store staff
9. Record and generate inventory report.

**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. Identify critical spares and consumables
 | * + Identification and analysis of maintainable critical spares and consumables.
	+ Determination of impact of equipment failure.
	+ Determination and selection of general and critical spares respectively.
	+ Confirmation of Spares and consumables availability.
 | * Observation
* Written
* Oral
* Practical
 |
| 1. Purchase requisition for spares and consumables
 | * + Organisational procedures
	+ Legal
	+ Ethical
	+ Consulting procurement personnel.
	+ Sourcing of spares and consumables.
	+ Selection of critical Spares.
	+ Negotiation with suppliers.
	+ Procurement of products.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Inspect ordered spares and consumables
 | * + Analysis of purchase order documents.
	+ Analysis and certification of Delivery documents.
	+ Counting and confirmation of procured products.
	+ Checking of packaging information.
 | * Practical
* Oral
* Observation
* Written
 |
| 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.
	+ 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. Manage store staff
 | * + Hiring of store personnel.
	+ Supervision of store personnel.
	+ Delegation of store duties.
	+ Appraisal of store staff.
	+ Maintenance of personnel duty roster.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Record and generate inventory report
 | * + Generation of reorder level reports
	+ Recording of daily inventory.
	+ Compilation of daily inventory to generate monthly report
	+ Generation of annual report
	+ Maintenance of inventory and reports.
 | * 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/09/6/A

**Relationship to Occupational Standards**

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

**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
 | * + 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
 | * + 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
 | * + 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.
	+ Assessing work quality
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Perform mechanical bench works
 | * + Interpretation of Technical drawings.
	+ Mounting and setting of work piece.
	+ Tools and equipment selection.
	+ Production.
	+ Assessing work quality
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate milling machines
 | * + Interpretation of Technical drawings
	+ Mounting and setting of work piece
	+ Selection of cutting tools.
	+ Setting of machine parameters.
	+ Parts Production
	+ Assessing work quality.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate grinding machine
 | * + Interpretation of Technical drawings
	+ Mounting and setting of work piece
	+ Selection of grinding wheel.
	+ Parts production
	+ Assessing work quality
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Use hand tools
 | * + Selection of hand tools.
	+ Inspection of hand tools.
	+ Utilization, cleaning and storage of hand tools.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate hydraulic press
 | * 1. Obtaining work instructions.
	2. Operation of hydraulic press.
* Mounting of work piece
* Setting machine parameters.
* Operating of hydraulic press.
* Switching off.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate shaper machine
 | * + Interpretation of Technical drawings
	+ Mounting and setting of work piece
	+ Selection of cutting tools.
	+ Production
	+ Assessing work quality
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate power hacksaw
 | * + Checking of blade condition.
	+ Mounting of work piece
	+ Machine operation.
	+ Lubrication.
	+ Assessing work quality
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Operate drilling machine
 | * + 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.
	+ Assessing work quality.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Perform foundry works
 | * + 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.

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| **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 |

##  PRODUCTION PLANT MANAGEMENT

**UNIT CODE:** ENG/CU/MPE/CR/10/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency:  **Manage plant production process**

**Unit description**

This unit describes the competencies required by a technician to manage plant production process. It involves competencies required to set up production process, operationalize production process, maintain production targets, control stock utilization, oversee plant maintenance, maintain production records, manage storage of raw materials and production outputs, manage production rejects and manage safety operations

**Summary of Learning Outcomes**

1. Set up production process
2. Operationalize production process
3. Maintain production targets
4. Control raw materials utilization
5. Coordinate plant maintenance
6. Maintain production records
7. Manage storage of raw materials and production outputs
8. Manage production rejects
9. Manage safety operations
10. Manage sectional staff

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

|  |  |  |
| --- | --- | --- |
| Learning Outcome | **Content** | **Suggested Assessment Methods** |
| 1. Set up production process
 | * + Identification of products and raw materials.
	+ Checking of raw materials.
	+ Inspection of production machine.
	+ Confirmation of labour availability.
	+ Inspection of production lines
	+ Safety
	+ Testing of production line.
 | * Practical
* Observation
* Written
* Oral
 |
| 1. Operationalize production process
 | * Adjusting production line settings.
* Running of production line.
* Checking of products against expected standards.
* Identification and rectification of faults.
* Arranging and packing of finished products.
* Removing and securing of rejects.
 | * Observation
* Written
* Oral
* Practical
 |
| 1. Maintain production targets
 | * Setting of production targets.
* Informing production personnel.
* Assigning targets to personnel.
* Follow up of set targets.
* Reviewing of achieved targets.
* Assessing and ascertaining of production targets.
* Maintaining of records.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Control raw materials utilization
 | * Defining of raw material requirements.
* Re-ordering of raw materials.
* Maintaining raw material records.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Coordinate plant maintenance
 | * Routine inspections of machines
* Planning of maintenance schedules
* Availing of production machines for maintenance
* Maintaining records
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Maintain production records
 | * Identification of information and data.
* Identification of data recording methods.
* Recording of production information and data.
* Generating production reports.
* Processing and storage of records.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Manage storage of raw materials and production outputs
 | * Cleaning and maintaining of storage areas.
* Special storage of hazardous and fragile materials and finished products.
* Updating of storage records.
* Inspection of raw materials and finished products.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Manage production rejects
 | * Maintenance of plant machinery.
* Training of production staff.
* Setting of production parameters.
* Inspection of finished products
* Isolation of rejects.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Manage safety operations
 | * Safety
* Personal protective equipment
* Daily safety inspections.
* Safety signage
* 5’s implementation.
* Conducting first aid operations.
* Collecting personnel safety feedback.
* Setting of safety goals
* Reviewing of plant inspection report.
 | * Practical
* Oral
* Observation
* Written
 |
| 1. Manage sectional staff
 | * Planning and development of leave rota
* Allocation of jobs.
* Complying with set time schedules.
* Resolution of Disputes.
* Staff appraisal
 | * 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.

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| **Recommended** **Tools, Equipment, Materials and supplies*** Workshop (electrical / mechanical / hydraulics
* Testing machines.
* Mechanical tool box.
* Stationery
* Protective gear
* Lifting equipment
* Printers
* Computers
* Data collection devices
* Calculators
* Storage facility.
* Lighting.
* First aid kits
* Production manuals.
 |
| **Reference materials**Manufacturers service manuals for all the modulesPlant engineering text books |