****

**REPUBLIC OF KENYA**

**COMPETENCY-BASED CURRICULUM**

**FOR**

**INDUSTRIAL PLANT OPERATIONS**

**LEVEL 5**



TVET CDACC

P.O. BOX 15745-00100

NAIROBI

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# FOREWORD

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

**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 to reform curriculum development, assessment and certification. This called for a shift to CBET in order 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.

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

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

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

I am grateful to the Council Members, Council Secretariat, 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 organisations.

I appreciate the funding of the Government of Canada and its implementing partner Colleges and Institutes Canada (CICan) which enabled the development of this curriculum through the Kenya Education for Employment Program (KEFEP).

I also appreciate the Kisumu National Polytechnic and its Canadian technical partners from Humber College who collaborated to identify industry skills gaps and develop this curriculum.

I recognize with appreciation the role of industry partners including the National Polytechnic’s Industry Advisory Committee and the Engineering Sector Skills Advisory Committee (SSAC) in ensuring that competencies required by the industry are addressed in the curriculum. I also thank all stakeholders in the 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 this sector acquire competencies that will enable them to perform their work more efficiently.

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

**COUNCIL SECRETARY/CEO**

**TVET CDACC**

# 

# ACRONYMNS AND ABBREVIATIONS

CAD Computer Aided Design

CBET Competency Based Education and Training

CDACC Curriculum Development Assessment and Certification Council

CU Curriculum

EMCA Environmental Management and Conservation Act

KCSE Kenya Certificate of Secondary Education

KNQA Kenya National Qualifications Authority

MOE Ministry of Education Science and Technology

NGO Non-Governmental Organization

NOS National Occupation Standard

OS Occupational Standard

OSHA Occupation Safety and Health Act

PPE Personal Protective Equipment

RPL Recognition of Prior Learning

SSAC Sector Skills Advisory Committee

TVET Technical and Vocational Education and Training

MHE Material Handling Equipment

EHS Environment Health and Safety

KEBS Kenya Bureau of Standards

# KEY TO UNIT CODE

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

Industry or sector

Curriculum

Occupational area

Type of competency

Competency number

Competency level

Version Control

# COURSE DESCRIPTION

This course is designed to equip an Industrial Plant Operator with the competencies required to perform various duties aligned to this sector.

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

**BASIC UNITS OF LEARNING**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning Code** | **Unit of Learning Title** | **Duration in Hours** | **Credit Factor** |
| ENG/CU/IPO/BC/01/5/A | Communication skills | 20 | 2 |
| ENG/CU/IPO/BC/02/5/A | Digital literacy | 50 | 5 |
| ENG/CU/IPO/BC/03/5/A | Entrepreneurial skills | 50 | 5 |
| ENG/CU/IPO/BC/04/5/A | Employability skills | 40 | 4 |
| ENG/CU/IPO/BC/05/5/A | Environmental literacy | 20 | 2 |
| ENG/CU/IPO/BC/06/5/A | Occupational health and safety | 30 | 3 |
| **TOTAL** | | **210** | **21** |

**COMMON UNITS OF LEARNING**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning Code** | **Unit of Learning Title** | **Duration in Hours** | **Credit Factor** |
| ENG/CU/IPO/CC/01/5/A | Applying Engineering Mathematics | 80 | 8 |
| ENG/CU/IPO/CC/02/5/A | Applying Electrical and Electronics Principles | 60 | 6 |
| ENG/CU/IPO/CC/03/5/A | Technical Drawing | 80 | 8 |
| ENG/CU/IPO/CC/04/5/A | Workshop Processes and Practices | 60 | 6 |
| **TOTAL** | | **280** | **28** |

**CORE UNITS OF LEARNING**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning Code** | **Unit of Learning Title** | **Duration in Hours** | **Credit Factor** |
| ENG/CU/IPO/CR/01/5/A | Industrial Boiler Operations and Maintenance | 80 | 8 |
| ENG/CU/IPO/CR/02/5/A | Industrial Steam Turbine Operations and Maintenance | 80 | 8 |
| ENG/CU/IPO/CR/03/5/A | Industrial Hydraulic Systems Operations and Maintenance | 70 | 7 |
| ENG/CU/IPO/CR/04/5/A | Industrial Pneumatic Systems Operations and Maintenance | 70 | 7 |
| ENG/CU/IPO/CR/05/5/A | Industrial Material Handling Equipment Operations and Maintenance | 70 | 7 |
| ENG/CU/IPO/CR/06/5/A | Industrial Pumps Operations and Maintenance | 70 | 7 |
| Industrial Attachment | | 360 | 36 |
| **TOTAL** | | **800** | **80** |
| **GRAND TOTAL** | | **1290** | **129** |

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

The total duration of the course is 1290 hours inclusive of industrial attachment

**Entry Requirements**

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

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

**Or**

Level 4 certificate in a related course with **one** year of continuous work experience

**Or**

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

**Industrial attachment**

An individual enrolled in this course will be required to undergo an industrial attachment in a firm dealing with Industrial Plant Engineering for a period of at least 360 hours. Attachment will be undertaken upon completion of the course or the unit of learning.

**Assessment**

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

**Certification**

A candidate will be issued with a Certificate of Competency on demonstration of competence in a unit of competency. To attain the qualification Industrial Plant Technician Level 5, the candidate must demonstrate competence in all the units of competency as given in qualification pack. These certificates will be issued by TVET CDACC in conjunction with training provider.

# BASIC UNITS OF LEARNING

**COMMUNICATION SKILLS**

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate communication skills

**Duration of Unit:** 25hours

**Unit Description**

This unit describes the competencies required to use specialized communication skills to meet specific needs of internal and external clients, conduct interviews, facilitate discussion with groups and contribute to the development of communication strategies.

**Summary of Learning Outcomes**

1. Meet communication needs of clients and colleagues
2. Contribute to the development of communication strategies
3. Conduct interviews
4. Facilitate group discussions
5. Represent the organization

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. 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 | * Observation * Oral Questions |
| 1. Contribute to the development of communication strategies | * Dynamics of groups * Styles of group leadership * Openness and flexibility in communication * Communication skills relevant to client groups | * Written tests * Observation |
| 1. Conduct interviews | * Types of interview * Establishing rapport * Facilitating resolution of issues * Developing action plans | * Written tests * Observation |
| 1. Facilitate group discussions | * Identification of communication needs * Dynamics of groups * Styles of group leadership * Presentation of information * Encouraging group members participation * Evaluating group communication strategies | * Written tests * Observation |
| 1. Represent the organization | * Presentation techniques * Development of a presentation * Multi-media utilization in presentation * Communication skills relevant to client groups | * Observation * Written tests |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

**DIGITAL LITERACY**

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

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate digital literacy

**Duration of Unit:** 45 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

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

**Suggested Delivery Methods**

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

**Recommended Resources**

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

# ENTREPRENEURIAL SKILLS

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

**Relationship to occupational standards**

This unit addresses the unit of competency: Demonstrate entrepreneurial skills

**Duration of unit:** 70 hours

**Unit description**

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

**Summary of Learning Outcomes**

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

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

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

**Suggested Delivery Methods**

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

**Recommended Resources**

* Case studies for small businesses
* Business plan templates
* Laptop/ desktop computers
* Internet
* Telephone
* Writing materials

**EMPLOYABILITY SKILLS**

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

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate employability skills

**Duration of Unit:** 50 hours

**Unit Description**

This unit covers competencies required to demonstrate employability skills. It involves 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 small teams

5. Plan and organize work

6. Maintain professional growth and development

7. Demonstrate workplace learning

8. Demonstrate problem solving skills

9. Demonstrate workplace ethics

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Conduct self-management | * Self-awareness * Formulating personal vision, mission and goals * Strategies for overcoming life challenges * Emotional intelligence * Assertiveness versus aggressiveness * Expressing personal thoughts, feelings and beliefs * Developing and maintaining high self-esteem * Developing and maintaining positive self-image * Articulating ideas and aspirations * Accountability and responsibility * Good work habits * Self-awareness * Self-development * Financial literacy * Healthy lifestyle practices | * Observation * Written questions * Oral interview * Third party report |
| 1. Demonstrate interpersonal communication | * Meaning of interpersonal communication * Listening skills * Types of audience * Writing skills * Reading skills * Meaning of empathy * Understanding customers’ needs * Establishing communication networks * Sharing information | * Observation * Written questions * Oral interview * Third party report |
| 1. Demonstrate critical safe work habits | * Stress and stress management * Punctuality and time consciousness * Leisure * Integratingpersonal objectives into organizational objectives * Resources utilization * Setting work priorities * HIV and AIDS * Drug and substance abuse * Handling emerging issues | * Observation * Written questions * Oral interview * Third party report |
| 1. Lead a small team | * Leadership qualities * Team building * Determination of team roles and objectives * Team performance indicators * Responsibilities in a team * Forms of communication * Complementing team activities * Gender and gender mainstreaming * Human rights * Maintaining relationships * Conflicts and conflict resolution | * Observation * Oral interview * Written questions * Third party report |
| 1. Plan and organize work | * Functions of management * Planning * Organizing * Time management * Decision making process * Task allocation * Evaluating work activities * Resource utilization * Problem solving * Collecting and organising information | * Observation * Oral interview * Written questions * Third party report |
| 1. Maintain professional growth and development | * Opportunities for professional growth * Assessing training needs * Licenses and certifications for professional growth and development * Pursuing personal and organizational goals * Identifying work priorities * Recognizing career advancement | * Observation * Oral interview * Written questions * Third party report |
| 1. Demonstrate workplace learning | * Managing own learning * Contributing to the learning community at the workplace * Cultural aspects of work * Variety of learning context * Application of learning * Safe use of technology * Identifying opportunities * Generating new ideas * Workplace innovation * Performance improvement * Handling emerging issues * Future trends and concerns in learning | * Observation * Oral interview * Written questions * Third party report |
| 1. Demonstrate problem solving skills | * Problem identification * Problem solving * Application of problem-solving strategies * Resolving customer concerns | * Observation * Oral interview * Written questions * Third party report |
| 1. Demonstrate workplace ethics | * Meaning of ethics * Ethical perspectives * Principles of ethics * Values and beliefs * 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 questions * 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/IPO/BC/05/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate environmental literacy

**Duration of Unit:** 25 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

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

**Suggested Delivery Methods**

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

**Recommended Resources**

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

**OCCUPATIONAL SAFETY AND HEALTH PRACTICES**

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

**Relationship to Occupational Standards**

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

**Duration of Unit:** 25 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify workplace hazards and risks | * Identification of hazards in the workplace and/or the indicators of their presence * Evaluation and/or work environment measurements of OSH hazards/risk existing in the workplace is conducted by * Authorized personnel or agency * Gathering of OHS issues and/or concerns raised | * Oral questions * Written tests * Observation of trainees identify hazards and risks |
| 1. Identify and implement appropriate control measure to hazards and risks | * Prevention and control measures, including use of PPE (personal protective equipment) for specific hazards are identified and implemented * Appropriate risk controls based on result of OSH hazard evaluation is recommended * Contingency measures, including emergency procedures during workplace incidents and emergencies are recognized and established in accordance with organization procedures | * Oral questions * Written tests * Practical test * Observation of implementation of control measures |
| 1. Implement OSH   programs, procedures  and policies/guidelines | * Providing information to work team about company OHS program, procedures and policies/guidelines * Participating in implementation of OSH procedures and policies/ guidelines * Training of team members and advice on OSH standards and procedures * Implementation of procedures for maintaining OSH-related records | * Oral questions * Written tests * Practical test * Observation |

**Suggested Delivery Methods**

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

**Recommended Resources**

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

# COMMON UNITS OF LEARNING

## WORKSHOP TECHNOLOGY

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

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

This unit addresses the unit of competency: Perform workshop practice

**DURATION OF UNIT:** 60 hours

**UNIT DESCRIPTION**

This unit describes the competencies required to prepare materials, tools and equipment, mark out dimensions and perform basic bench works such as filing, cutting, drilling and fastening based on the required performance standards.

**Summary of Learning Outcomes**

1. Prepare materials, tools and equipment
2. Mark out dimensions on work piece
3. Perform required basic metal works

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Prepare materials, tools and equipment | * Uses and specifications of materials, tools and equipment * Measuring, holding and cutting work pieces * Safety Practices * PPE * Handling of tools, materials and equipment * Good housekeeping | * Oral * Observation * Written test tests |
| 1. Mark out dimensions on work pieces | * Free hand sketching * Interpretation of working drawings * Measuring tools; functions and use * Measurements * Dimensioning * Unit conversion | * Oral * Observation * Written test tests |
| 1. Perform metal works | * Free hand sketching * Symbols representation * Interpretation of working drawings * Grinding, cutting, drilling, filing, shearing and folding techniques * Basic welding and brazing principles and application * Basic fittings * occupational health and safety | * Oral * Observation * Written test tests |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practice by trainee
* Field trips

**Recommended Resources**

* Measuring tools
* Drawing instruments
* Calculator
* Arc-welding equipment
* Gas welding equipment
* Portable grinder
* Hacksaw
* File
* Dot punch
* Centre punch
* Scribers
* Screw drivers
* Ballpein hammers
* Measuring tapes
* Steel rule
* Portable electric drill
* Brush wire
* Tri-square
* Chisels
* Snips
* Mallets

**PPEs**

* Goggles
* Gloves
* Overall
* Safety boots
* Masks

# ENGINEERING MATHEMATICS

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply Engineering mathematics

**DURATION OF UNIT:** 80 hours

**UNIT DESCRIPTION**

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

**Summary of Learning Outcomes**

1. Apply Algebra
2. Apply coordinate geometry
3. Apply trigonometry functions
4. Carry out mensuration
5. Apply statistics
6. Apply matrix
7. Apply vectors

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply Algebra | * Base and Index * Law of indices * Indicial equations * Laws of logarithm * Logarithmic equations * Conversion of basis * Use of calculator * Reduction of equations * Solution of equations reduced to quadratic form * Solutions of simultaneous linear equations in three unknowns * Solutions of problems involving AP and GP | * Written test tests * Oral questioning * Assignments * Supervised exercises |
| 2. Apply Coordinate Geometry | * Polar equations * Cartesian equation * Graphs of polar equations * Normal and tangents * Definition of a point * Locus of a point in relation to a circle * Loci of points for given mechanism | * Written test tests * Oral questioning * Assignments * Supervised exercises |
| 3. Apply trigonometric functions | * Half -angle formula * Factor formula * Trigonometric functions * Parametric equations * Relative and absolute measures * Measures calculation * Meaning of hyperbolic equations * Properties of hyperbolic functions * Evaluations of hyperbolic functions Hyperbolic identities * Osborne’s Rule * Ashx+bshx=C equation | * Written test tests * Oral questioning * Assignments * Supervised exercises |
| 4. Carry out mensuration | * 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 test tests |
| 5. Apply Statistics | * Classification of data   Grouped data  Ungrouped data   * Data collection * Tabulation of data   Class intervals  Class boundaries  Frequency tables   * Diagrammatic and graphical presentation of data e.g.   Histograms  Frequency polygons  Bar charts  Pie charts  Cumulative frequency curves   * Measures of central tendency mean, mode and median * Measures of dispersion   Variance and standard deviation   * Definition of probability * Laws of probability * Expectation variance and S.D. * Types of distributions * Mean, variance and SD of probability distributions * Application of probability distributions | * Assignments * Oral questioning * Supervised exercises * Written test tests * Simulation * Data modelling |
| 6. Apply Matrix methods | * Matrix operation * Determinant of 3x3 matrix * Inverse of 3x3 matrix * Solutions of linear simultaneous equations in 3 unknowns * Application of matrices | * Assignments * Oral questioning * Supervised exercises * Written test tests |
| 7. Apply Vectors | * Definition of dot and cross product of vectors * Solution of problems involving dot and cross production of cross * Definition of operators * Definition of vector field * Solutions of problems involving vector fields * Definition of Gradient, Divergence and curl * Solutions of involving Gradient, Divergence and curl * Application of vectors | * Assignments * Oral questioning * Supervised exercises * Written test tests |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

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

## ELECTRICAL PRINCIPLES

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply Electrical principles skills

**DURATION OF UNIT:** 60 hours

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of Electrical principles in their work which includes; Use the concept of basic Electrical quantities, use of the concepts of D.C and A.C circuits in electrical installation, use of basic electrical machine, use of power factor in electrical installation, use of earthing in Electrical installations, apply Electrostatic, apply Magnetism and Electromagnetism and finally transient in Electrical circuit analysis.

**Summary of Learning Outcomes**

1. Use the concept of basic Electrical quantities
2. Use the concepts of D.C and A.C circuits in electrical installation
3. Use of basic electrical machine
4. Use of power factor in electrical installation
5. Use of earthing in Electrical installations
6. Apply Electrostatics
7. Apply Magnetism and Electromagnetism
8. Apply Transient in Electrical circuit analysis

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + - Use the concept of basic Electrical quantities | * The meaning of SI unit * SI unit of various types of Electrical parameters * Ohm’s law * Calculations involving various Electrical parameters e.g. Power, Current, Voltage, Resistance * Instruments used in measuring various types of Electrical parameters | * Written test tests * Oral questioning * Assignments * Supervised exercises |
| * + - Use the concepts of D.C and A.C circuits in electrical installation | * Meaning of terms * AC and DC, parallel and series R-L, R-C, R-L-C circuits * AC and DC network theorems e.g. * Kirchhoff’s laws * Superposition * Thevenin’s * Norton’s * AC to DC and DC to AC Conversion | * Written test tests * Oral questioning * Assignments * Supervised exercises |
| * + - Use of basic electrical machine | * Types of single-phase Electrical machines * DC machines, * AC Single phase motors and generators * Transformers * Application of AC and DC machines | * Assignments * Oral questioning * Supervised exercises * Written test tests * Practical tests |
| * + - Use of power factor in electrical installation | * Meaning of power factor * Meaning of terms * Power triangle * Power factor correction | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written test tests |
| * + - Use of earthing in electrical installation | * + Meaning of Earthing   + Terms in Earthing   + Earthing points in Electrical installation   + Methods of earthing   + Factors to consider in selecting an earthing method   + Testing an earthing system | * Assignments * Supervised exercises * Written test tests * Practical test |
| * + - Apply Electrostatics | * Meaning of Electrostatic field * Sources of Electrical static field * Meaning of capacitor and capacitance * Meaning of terms * Types capacitors * Charging and discharging * Capacitors connection * Calculations involving capacitors | * Assignments * Oral questioning * Supervised exercises * Written test tests |
| * + - Apply Magnetism and Electromagnetism | * Meaning of Magnetism and magnetic fields * Sources of Magnetic field * Meaning of Teams * Electromagnetic losses e.g. Hysteresis, Leakage and flux fringing * Laws of Electromagnetism * Calculations in the Electromagnetism | * Assignments * Oral questioning * Supervised exercises * Written test tests |
| * + - Apply transients in Electrical Circuit Analysis | * + Meaning of Growth and decay in R-L & R-C circuits   + Calculations involving R-L& R-C circuits   + Application of Growth and decay in R-L & R-C Circuits | * Assignments * Oral questioning * Supervised exercises * Written test tests |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

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

## TECHNICAL DRAWING

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

**Relationship to Occupational Standards**

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

**DURATION OF UNIT:** 80 hours

**UNIT DESCRIPTION**

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

**Summary of Learning Outcomes**

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

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Use and maintain drawing equipment and materials | * Identification and care of drawing equipment * Identification and care of drawing materials * Reference to manufacturer’s instructions and work place procedures on use and maintenance of drawing equipment and materials * Reference to relevant environmental legislations * Use of Personal Protective Equipment (PPEs) | * Observation * Oral questioning * Written test tests |
| 1. Produce plane geometry drawings | * Types of lines in drawings * Construction of geometric forms e.g. squares, circles * Construction of different angles * Measurement of different angles * Bisection of different angles and lines * Standard drawing conventions | * Oral questioning * Practical tests * Observation |
| 1. Produce solid geometry drawings | * Interpretation of sketches and drawings of patterns e.g. cylinders, prisms and pyramids * Sectioning of solids e.g. prisms, cones * Development and interpenetrations of solids e.g. cylinder to cylinder and cylinder to triangular, prism | * Observation * Practical tests * Oral questioning |
| 1. Produce orthographic drawings | * Meaning of pictorial and orthographic drawings * Meaning of sectioning * Meaning of symbols and abbreviations * Drawing and interpretation of orthographic elevations * Dimensioning of orthographic elevations * Sectioning of views * Assembly drawing | * Observation * Practical tests * Oral questioning |
| 1. Produce plant drawings | * Plant symbols and abbreviations * Meaning of plant symbols drawings * Drawing of plant diagrams e.g. block, schematic, circuit and line | * Observation * Oral questioning * Practical tests |

**Suggested Methods of Delivery**

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

**Recommended Resources**

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

# CORE UNITS OF LEARNING

## MAINTAINING INDUSTRIAL BOILERS

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Maintain Industrial Boilers

**DURATION OF UNIT:** 80 hours

**UNIT DESCRIPTION**

This unit covers competencies required to maintaining industrial boilers. It involves applying industrial boiler maintenance safety procedures, conducting routine/preventative industrial boiler maintenance, troubleshooting equipment/ component faults, conducting industrial boiler maintenance-commissioning industrial boiler operations and preparing industrial boiler maintenance report.

**Summary of Learning Outcomes**

1. Apply Industrial boiler maintenance safety Procedures
2. Conduct routine/preventative industrial boiler maintenance
3. Troubleshoot equipment/ component faults
4. Conduct industrial boiler maintenance
5. Re-commissioning industrial boiler Operations
6. Prepare Industrial boiler maintenance report

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

| **Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| * 1. Apply Industrial boiler maintenance safety Procedures | * **Identify personal safety gear** * Thermally insulated gloves * Helmet * Ear protection (muffs or plugs) * Respiratory devices eye protection * Working protective gloves * Whole body fire-resistant clothing * Safety boots | * Written test * Oral Questions * Observation |
| * **Observe Occupational Health and Safety Act** * Personal safety equipment * Responsibility of the employee * Responsibility of the employer * Work area safety * Work area hazards * Accident reporting procedure | * Written test * Oral Questions Observation |
| * 1. Conduct routine/preventative industrial boiler maintenance | * **Work Plan** * Follow SOPs * Review Logs, daily check charts and manufactures manual * Identify Tools and equipment * Types of maintenance * Annual maintenance * Quarterly maintenance * Main components to check regularly * Water gauges * Pipes and float chambers * Condensate recovery system * Corrosion and leakages in the system * Air – fuel ratio analysis * Stack gauge * Heat transfer surfaces | * Written test * Oral Questions * Observation |
| * 1. Troubleshoot equipment/ component faults | * + Testing industrial boiler alarm systems   + Testing blow down valve and safety relieve valves   + Conducting Industrial boiler water tests; * pH * Hardness Test * Total Dissolved Solids (TDS) * Suspended Solids * Turbidity Test * Dissolved Oxygen * Conductivity * Biological Oxygen Demand (BOD) Test * Chemical Oxygen Demand (COD) test   + Checking Industrial boiler pneumatic valves   + Testing industrial boiler conveyors to ensure emergency buttons are working   + Checking Deorator and Morbraen switch water level   + Determine Impurities in Boiler feed Water; * Oil * Dissolved solids * Suspended solids * Dissolved gases * Organic materials * Identification of Industrial boiler common faults * Filtration/ Ultra-filtration * Ion exchange/ Softening * Deaeration/ Degasification * Coagulation/ Chemical precipitation * Membrane processes e.g. Reverse osmosis, nano-filtration * Identification of industrial boiler common faults * Formation of scales * Corrosion * Vibration * Wear * Overheating * Cracks * Analysis of test data * Graphs * Figures * Images (Image quality Indicator, IQI) * Periodic noise levels are carried out | * Written test * Oral Questions * Observation |
| * 1. Conduct industrial boiler maintenance | **Perform Maintenance Operations**   * Adherence to Meantime to repair * Isolation of Faulty boiler auxiliary/ component and overhauled for service * Updating and maintaining Inventory of spares records * Checking and Lubricating moving parts * Closing All manholes Properly * Removing and replacing worn out parts * Aligning shafts * Lubricating moving parts * Repairing parts where necessary * Performing Industrial boiler General Cleaning * Returning plant to required operational status upon completion of test | * Written test * Oral Questions * Observation |
| * 1. Re-commissioning industrial boiler Operations | **Carry out test run**   * Performing pre-start up procedure * Monitoring performance * Updating inventory * Filling log books * Performing housekeeping procedures | * Written test * Oral * Observation |
| * 1. Prepare Industrial boiler maintenance report | * Report writing techniques * Report presentation techniques | * Written test * Oral Questions * Observation |

## MAINTAINING INDUSTRIAL STEAM TURBINE

**UNIT CODE:** ENG/CU/IPO/CR/02/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Maintaining Industrial Steam Turbine

**DURATION OF UNIT:** 80 hours

**UNIT DESCRIPTION**

This unit covers competencies required to maintaining industrial steam turbine. It involves applying industrial steam turbine maintenance safety procedures, conducting routine/ preventative industrial steam turbine maintenance, troubleshooting industrial steam turbine equipment/ component faults, conducting industrial steam turbine maintenance-commissioning industrial steam turbine and perform operation test

and preparing industrial steam turbine maintenance report

**Summary of Learning Outcomes**

1. Apply Industrial steam turbine maintenance safety Procedures
2. Conduct routine/ preventative industrial steam Turbine maintenance
3. Troubleshoot industrial steam Turbine equipment/ component faults
4. Conduct industrial steam turbine maintenance
5. Re-commission industrial steam turbine and perform operation test
6. Prepare industrial steam turbine maintenance report

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

| **Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply Industrial steam turbine maintenance safety Procedures | * **Identification of personal safety gear** * Thermally insulated gloves * Helmet * Ear protection (muffs or plugs) * Respiratory devices eye protection * Working protective gloves * Whole body fire-resistant clothing * Safety boots | * Written test * Oral Questions * Observation |
|  | * **Observation of Occupational Health and Safety Act** * Personal safety equipment * Responsibility of the employee * Responsibility of the employer * Work area safety * Work area hazards * Accident reporting procedure | * Written test * Oral Questions * Observation |
| 1. Conduct routine/ preventative industrial steam Turbine maintenance | * Implementation of log charts, daily check charts and steam turbine reports * Identification of tools and equipment for maintenance activities * Consumable items * Hand tools   Repairing/replacement of leaking tubes/pipes | * Written test * Oral Questions * Observation |
| 1. Troubleshoot industrial steam Turbine equipment/ component faults | **Conduct pre-operational checks**   * Valves: - Main stop, Trip and Throttle, Intercept * Contaminants in steam * Wear of mating parts * Damaged seats * Leaking stuffing boxes * Lube oil systems * Steam and Drain connection * Governors/ Over-speed protection systems * Rotating blading/ buckets and discs/wheels * Shafts, Rotors, Bearings, Seals * Nozzles/ Stationary blading and diaphragm * Casing, Blade rings and Shells * Electro-hydraulic control systems * Check exhaust steam discharge valves | * Written test * Oral Questions * Observation |
| 1. Conduct industrial steam turbine maintenance | **Perform Maintenance Operations**   * Adherence to Meantime to repair as per laid down procedures and standards * Servicing Water strainers * Fixing tube /pipe leaks * Addressing oil leaks * Inventory of spares records are updated and maintained according to SOP * Return plant to required operational status upon completion of test | * Written test * Oral Questions * Observation |
| 1. Re-commission industrial steam turbine and perform operation test | **Carrying out test run**   * Performing pre-start up procedure   **Monitoring and Recording performance**   * Lube, seal, and control oil pressures and temperatures * Bearing temperatures * Cooling water * Steam flow rates * Inlet and Exhaust steam pressures and temperatures * Rotor/ shaft speeds * Governors * Update inventory * Fill log books * Perform housekeeping procedures | * Written test * Oral Questions * Observation |
| 1. Prepare industrial steam turbine maintenance report | * Report writing techniques * Report presentation techniques | * Written test * Oral Questions * Observation |

## MAINTAINING INDUSTRIAL HYDRAULIC SYSYTEMS

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Maintain Industrial Hydraulics Systems

**DURATION OF UNIT:** 70 hours

**UNIT DESCRIPTION**

This unit covers competencies required maintain Industrial Hydraulics Systems. It involves applying industrial hydraulic maintenance safety procedures, conducting routine/preventative maintenance industrial hydraulic system, conducting industrial hydraulic system maintenance-commissioning industrial hydraulic system and perform operation test and preparing industrial hydraulic system maintenance report.

**Summary of Learning Outcomes**

1. Apply Industrial hydraulic maintenance safety Procedures
2. Conduct routine/ preventative maintenance industrial hydraulic system
3. Conduct industrial hydraulic system maintenance
4. Re-commission industrial hydraulic system and perform operation test
5. Prepare industrial hydraulic system maintenance report

**Learning Outcomes, Content and Suggested Methods**

| **Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply Industrial hydraulic maintenance safety Procedures | * **Identification of personal safety gear** * Helmet * Working protective gloves * Safety boots * Working protective clothing * **Observation of Occupational Health and Safety Act** * Personal safety equipment * Responsibility of the employee * Responsibility of the employer * Work area safety * Work area hazards * Accident reporting procedure * **Identify risks and hazards in hydraulic systems** * Uncontrolled leakage of the hydraulic fluid * Accidental machine movement * Risk of burning at hot surfaces or hot hydraulic fluid * Parts coming off or bursting * Skin diseases * Noise | * Written test * Oral Questions * Observation |
| 1. Conduct routine/ preventative maintenance industrial hydraulic system | * Implementation of log charts, daily check charts and steam turbine reports * Identification of tools and equipment for maintenance activities * Consumable items * Hand tools   Repairing/replacement of leaking tubes/pipes | * Written test * Oral Questions * Observation |
| 1. Conduct industrial hydraulic system maintenance | * Performing Basic Repair and Maintenance * Remove and replace or repair worn out parts – e.g. hoses, sealing sleeves, pistons, gears * Replace O-rings, seals, Circlip rings, gaskets and Cotter pin * Align shafts * Lubricate moving parts * Replace hydraulic oil and filters when necessary * General maintenance, i.e. cleaning, visual checks, recording and reporting * Preventive maintenance requirements * Review operating data and trends * Walk –around inspection for unusual noises and leaks | * Written test * Oral Questions * Observation |
| 1. Re-commission industrial hydraulic system and perform operation test | **Carrying out test run**   * + Performing pre-start up procedure   + Monitoring and Recording performance   + Lube, seal, and control oil and pressures   + Commission for Operation | * Written test * Oral * Observation |
| 1. Prepare industrial hydraulic system maintenance report | * Report writing techniques * Report presentation techniques | * Written test * Oral Questions * Observation |

## MAINTAINING INDUSTRIAL PNEUMATIC SYSTEMS

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Maintain Industrial Pneumatic System

**DURATION OF UNIT:** 70 hours

**UNIT DESCRIPTION**

This unit covers competencies required to maintain industrial pneumatic system. It involves applying industrial pneumatic maintenance safety procedures, conducting routine/ preventative maintenance pneumatic system, troubleshooting industrial pneumatic systems for faults, conducting industrial pneumatic system maintenance-commissioning industrial pneumatic system and perform operation test, preparing industrial pneumatic system maintenance report.

**Summary of Learning Outcomes**

1. Apply Industrial pneumatic maintenance safety Procedures
2. Conduct routine/ preventative maintenance pneumatic system
3. Troubleshoot industrial pneumatic systems for faults
4. Conduct industrial pneumatic system maintenance
5. Re-commission industrial pneumatic system and perform operation test
6. Prepare industrial pneumatic system maintenance report

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

| **Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply Industrial pneumatic maintenance safety Procedures | * **Identification of personal safety gear** * Helmet * Working protective gloves * Safety boots * Working protective clothing * **Observation of Occupational Health and Safety Act** * Personal safety equipment * Responsibility of the employee * Responsibility of the employer * Work area safety * Work area hazards * Accident reporting procedure * **Identifying risks and hazards in Pneumatic systems** * Uncontrolled leakage of the Pneumatic gas * Accidental machine movement * Risk of burning at hot surfaces or hot hydraulic fluid * Parts coming off or bursting * Skin diseases * Noise | * Written test * Oral Questions * Observation |
| 1. Conduct routine/ preventative maintenance pneumatic system | * Implementation of log charts, daily check charts and pneumatic reports * Identification of tools and equipment for maintenance activities * Consumable items * Hand tools   Repairing/replacement of leaking tubes/pipes | * Written test * Oral Questions * Observation |
| 1. Troubleshoot industrial pneumatic systems for faults | * Observation of safety procedures * Checking for leakages * Visual inspection * Checking for the correct pressure levels * Isolation of the system to identify faults * Checking for lubrication * Checking for actuator alignment * Checking for correct flowrate * Making a list of probable causes * Review Maintenance Documents * Logs, daily check charts and reports * Review Manufacturers manuals including functional diagrams * Identification of tools and equipment * Fastening tools * Measurement tools * Cutting tools * Joining equipment * Analyzers * Identification of Common Pneumatic Systems failures/faults * Foaming * Vibration * Wear * Overheating * Cracks * Particles/Debris accumulation * Incorrect flow * Incorrect pressure * Insufficient forces and torques at the drivers * Jerky cylinder movement (Variation in pressure or flow) * Output not running or running too slow (No or too low delivery flow) * Expressive operating temperature * Foaming of Pneumatic fluid * Coasting cylinder * Line impacts when shifting * Leaks * Cracks * Identification of Required Equipment for Servicing and maintenance * Vibration analyzer * Infrared Thermography * Ultrasonic leak detectors * Fluid/ Oil analyzer * Wear and dimensional measurement * Pulse recorder * Borescopic inspection | * Written test * Oral Questions * Observation |
| 1. Conduct routine/ preventative maintenance pneumatic system | * Identification of Pneumatic system components and their functions * Air compressors * Air pressure regulating valves * Relief valves * Dump valves * Air pressure control valves * Air activated cylinders * Air receivers * Air dryers * Fail-safe/ Emergency systems components * Circuit diagrams and their interpretation   **Operations**   * Air braking systems * Presses * Pneumatic tools   **Performing Repair and Maintenance**   * Remove and replace or repair worn out parts – e.g. hoses, sealing sleeves, pistons, gears * Replace O-rings, seals, Circlip rings, gaskets and Cotter pin * Align shafts * Lubricate moving parts * Replace hydraulic oil and filters when necessary * General maintenance, i.e. cleaning, visual checks, recording and reporting * Preventive maintenance requirements * Review operating data and trends * Walk –around inspection for unusual noises and leaks | * Written test * Oral Questions * Observation |
| 1. Conduct industrial pneumatic system maintenance | * Perform Repair and Maintenance * Removing and replacing or repair worn out parts – e.g. hoses, sealing sleeves, pistons, gears * Replacing O-rings, seals, Circlip rings, gaskets and Cotter pin * Aligning shafts * Lubricating moving parts * Replacing Pneumatic oil and filters when necessary * General maintenance, i.e. cleaning and visual checks * Re-assemble the system * Confirm the operating parameters * Update Inventory * Update Maintenance Log | * Written test * Oral Questions * Observation |
| 1. Re-commission industrial pneumatic system and perform operation test | * **Carrying out test run** * Performing pre-start up procedure * Monitoring and Recording performance of the pneumatic system * Commission for operation | * Written test * Oral Questions * Observation |
| 1. Prepare industrial pneumatic system maintenance report | * Report writing techniques * Report presentation techniques | * Written test * Oral Questions * Observation |

## MAINTAINING INDUSTRIAL MATERIAL HANDLING EQUIPMENT

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency:Maintain Industrial Material Handling Equipment

**DURATION OF UNIT:** 70 hours

**UNIT DESCRIPTION**

This unit covers competencies required to maintain industrial material handling equipment. It involves applying industrial material handling equipment maintenance safety procedures, conducting routine/ preventative maintenance for material handling equipment, troubleshooting industrial material handling equipment for faults, performing industrial MHE repair and maintenance, MHE pretesting procedures, reporting and documentation.

**Summary of Learning Outcomes**

1. Apply Industrial material handling equipment maintenance safety Procedures
2. Conduct routine/ preventative maintenance for material handling equipment
3. Troubleshoot industrial material handling equipment for faults
4. Perform Industrial MHE Repair and Maintenance
5. Perform MHE pretesting Procedures
6. Reporting and Documentation

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

| **Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply Industrial material handling equipment maintenance safety Procedures | * Safety, Health and Security Measures * Comply with safety regulations and procedures * Wear safety equipment while working * Follow organization procedures * Recognize and report unsafe conditions and practices * Identify reasons for occurrence of incident * Report deviations from standard protocols | * Written test * Oral Questions * Observation |
| 1. Conduct routine/ preventative maintenance for material handling equipment | * Performing ***tests*** * Servicing MHE auxiliaries * Tightening Loose bolts and fittings * Lubricating Moving parts * Servicing and or replacing Filters * Servicing/ Replacing Seals, gaskets and Cotter * Check Oil levels and service | * Written test * Oral * Observation |
| 1. Troubleshoot industrial material handling equipment for faults | * Performance of pre operational checks * Checking the functionality of the equipment for errors * Diagnosis of the equipment to identify faults and errors | * Written test * Oral * Observation |
| 1. Perform MHE operation test | * + Test running MHE and monitoring to detect deviation from the normal ***operating procedures***   + Taking Corrective action to rectify ***abnormalities*** when detected | * Written test * Oral Questions * Observation |
| 1. Reporting and Documentation | * Inventory is updates * maintenance records | * Written test * Oral Questions * Observation |

## MAINTAINING INDUSTRIAL PUMP

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

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Maintain Industrial Pump

**DURATION OF UNIT:** 70 hours

**UNIT DESCRIPTION**

This unit covers competencies required to maintain industrial pump. It involves applying industrial pump maintenance safety procedures, conducting routine/ preventative maintenance for industrial pumps troubleshooting industrial pumps for faults, performing industrial pumps maintenance, industrial pump operation test and preparing industrial pump maintenance report.

**Summary of Learning Outcomes**

1. Apply Industrial pump maintenance safety procedures
2. Conduct routine/ preventative maintenance for industrial pumps
3. Troubleshoot industrial pumps for faults
4. Perform industrial pumps maintenance
5. Perform industrial pump operation test
6. Prepare industrial pump maintenance report

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

|  |  |  |
| --- | --- | --- |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 1. Apply Industrial pump maintenance safety Procedures | * **Identify personal safety gear** * Helmet * Ear muffs * Working protective gloves * Safety boots * Working protective clothing * **Observe Occupational Health and Safety Act** * Personal safety equipment * Responsibility of the employee * Responsibility of the employer * Work area safety * Work area hazards * Accident reporting procedure | * Written test * Oral Questions * Observation |
| 1. Conduct routine/ preventative maintenance for industrial pumps | * Performing ***tests*** * Servicing MHE auxiliaries * Tightening Loose bolts and fittings * Lubricating Moving parts * Servicing and or replacing Filters * Servicing/ Replacing Seals, gaskets and Cotter * Check Oil levels and service | * Written test * Oral Questions * Observation |
| 1. Troubleshoot industrial pumps for faults | * Conducting pre-operational checks * Testing for functionality of the pump to identify abnormal performance * Diagnosis of the pump problems to identify the faults | * Written test * Oral Questions * Observation |
| 1. Perform industrial pumps Maintenance | * + Restoring all clearances and tolerances   + Servicing / Replacing Seals, O-rings, glands, main shafts, impeller lock nuts, impeller, both drive-end and non-drive -end bearings   + Identifying Right lubrication (food grade or non-food grade)   + Performing Pump alignment using Dial Test indicator   + Checking coupling for wear and tear   + Pumps next due date for service is updated on the check card and pump schedule   + Tools and material inventory are updated | * Written test * Oral Questions * Observation |
| 1. Perform industrial pump operation test | * + Test running the pump for deviation detection from normal operation procedures   + Re-Commissioning of the pump for operation | * Written test * Oral Questions * Observation |
| 1. Reporting and Documentation | * Update inventory * Update pumps next due date record * Update daily check cards | * Written test * Oral Questions * Observation |