****

**REPUBLIC OF KENYA**

**COMPETENCY-BASED CURRICULUM**

**FOR**

**INDUSTRIAL PLANT OPERATIONS AND MAINTENANCE**

**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 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 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 Mechatronic 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, Industrial Plant 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 national 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**

# ACRONYMS

|  |  |
| --- | --- |
| TVET:  | Technical and Vocational Education and Training |
| CDACC: | Curriculum Development, Assessment and Certification Council |
| CBET:  | Competency-Based Education and Training |
| ICT:  | Information Communication Technology |
| NEMA:  | National Environment Management Authority |
| OSH:  | Occupational Safety and Health  |
| SOPs:  | Standard Operating Procedures  |
| NEMA:  | National Environment Management Authority |
| OS: | Occupational Standards |

# KEY TO UNIT CODE

 ENG/CU/IPOM/BC/01/6/A

Industry or sector

Curriculum

Occupational area

Type of competency

Competency number

Competency level

# COURSE DESCRIPTION

Certified Industrial Plant Operator and Maintenace qualification consists of competencies that a person must achieve to enable him/her to maintain boilers, steam turbine, hydraulic systems, systems, material handling equipments and maintain pumps.

|  |
| --- |
| **BASIC UNITS OF COMPETENCY** |
| **Unit of Learning Code**  | **Units of Learning Title**  | **Duration in Hours**  | **Credits Factors** |
| ENG/CU/IPOM/BC/01/6/A | Communication skills | 40 | 4 |
| ENG/CU/IPOM/BC/02/6/A | Digital literacy | 60 | 6 |
| ENG/CU/IPOM/BC/03/6/A | Entrepreneurial skills | 100 | 10 |
| ENG/CU/IPOM/BC/04/6/A | Employability skills | 80 | 8 |
| ENG/CU/IPOM/BC/05/6/A | Environmental literacy | 40 | 4 |
| ENG/CU/IPOM/BC/6/A/6/A | Occupational health and safety | 40 | 4 |
| **TOTAL** | **360** | 36 |
| **COMMON UNITS OF COMPETENCY** |
| ENG/CU/IPOM/CC/01/6/A | Applying Engineering Mathematics | 144 | 14.4 |
| ENG/CU/IPOM/CC/02/6/A | Applying Electrical and Electronics Principles | 96 | 9.6 |
| ENG/CU/IPOM/CC/03/6/A | Technical Drawing | 144 | 14.4 |
| ENG/CU/IPOM/CC/04/6/A | Apply Mechanical Engineering Science Principles | 96 | 9.6 |
| ENG/CU/IPOM/CC/05/6/A | Apply Fluid Mechanics Principles | 96 | 9.6 |
| ENG/CU/IPOM/CC/6/A/6/A | Apply Thermodynamics Principles | 96 | 9.6 |
| ENG/CU/IPOM/CC/07/6/A | Apply Material and Metallurgical Process Principles | 96 | 9.6 |
| **TOTAL** | **768** | 96 |
| **CORE UNITS OF COMPETENCY** |
| ENG/CU/IPOM/CR/01/6/A | Industrial Boiler Operations and Maintenance | 160 | 16 |
| ENG/CU/IPOM/CR/02/6/A | Industrial Steam Turbine Operations and Maintenance | 160 | 16 |
| ENG/CU/IPOM/CR/03/6/A | Industrial Hydraulic Systems Operations and Maintenance | 128 | 12.8 |
| ENG/CU/IPOM/CR/04/6/A | Industrial Pneumatic Systems Operations and Maintenance | 128 | 12.8 |
| ENG/CU/IPOM/CR/05/6/A | Industrial Pumps Operations and Maintenance | 128 | 12.8 |
| ENG/CU/IPOM/CR/05/6/A | Industrial Steam Distribution Line Operations and Maintenance | 160 | 16 |
| ENG/CU/IPOM/CR/6/A/6/A | Industrial Attachment | 480 | 48 |
| **TOTAL**  | **1344** | **134.4** |
| **GRAND TOTAL** | **2472** | **247.2** |

The total duration of the course is **247.2** hours which is equivalent to 83 weeks at 30 hours of learning per week.

1. **Entry Requirements**

A trainee entering this course should have any of the following minimum requirements:

1. Kenya Certificate of Secondary Education (KCSE) mean grade C- (minus).

**Or**

1. Industrial Plant Operations and Maintenance Level 5 Certificate

**Or**

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

An individual enrolled in this course will undergo four hundred and eighty (480) hours industrial attachment in a welding and fabrication firm.

An individual enrolled in one of the core units of learning will undergo a forty (40) hours attachment.

1. **Assessment**

The course will be assessed at two levels: internal and external.

1. **Internal assessment**: conducted continuously by the trainer (internal assessor) who is monitored by an accredited internal verifier.
2. **External assessment**: conducted by an external assessor who is monitored by an accredited external verifier.

The assessors and verifiers are accredited by TVET CDACC which also coordinates external assessment.

**Certification**

An individual will be awarded a Certificate of Competency on demonstration of competence in a unit of competency. To be awarded a National Certificate in Welding and Fabrication Level 6, an individual must demonstrate competence in all the units of competency.

These certificates will be awarded by TVET CDACC in conjunction with the training provider.

# BASIC UNITS OF LEARNING

## COMMUNICATION SKILLS

**UNIT CODE:**  **ENG/CU/IPOM/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. Utilize specialized communication skills processes
2. Develop communication strategies
3. Establish and maintain communication pathways
4. Promote use of communication strategies
5. Conduct interview
6. Facilitate group discussion
7. Represent the organization

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

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

**Suggested Delivery Methods**

* Interview
* Role playing
* Observation

**Recommended Resources**

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

## DIGITAL LITERACY

**UNIT CODE:** **ENG/CU/IPOM/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 color 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/IPOM/BC/02/6/A**

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

This unit addresses the unit of competency: Demonstrate entrepreneurial skills

**DURATION OF UNIT:** 100 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. The trainee will prepare a workable food enterprise development business plan

**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
* Intra-preneurship and business growth
 | * Observation
* Case studies
* Individual/group assignments
* projects
* Written
* Oral
 |
| 1. Expand customers and product lines
 | * Market demand
* Regulatory environment
* Creating product and services competitive advantages
* Creating royal client base
* Identifying and maintain new customers and markets
* Advance product/ service promotions
* Advance market expansion
* Small business records management
* Book keeping and auditing for small businesses
* Computer application software and programmes
* ICT in customer and product diversification
 | * Oral
* Observation
* Case studies
* Individual/group assignments
* projects
* Written
 |
| 1. Motivate staff/workers
 | * Motivation of workers
* Communication at workplace for motivation purpose
* Problem solving
* Conflict resolution at place of work
* Good staff/workers relation
* Team building and team work
* Staff development and enhancement
* Culture of continuous improvement
 | * Observation
* Case studies
* Individual/group assignments
* projects
* Written
 |
| 1. Expand employed capital base
 | * Employed capital in business
* Business share holdings
* Types of shares
* Shares diversification
* Role of shareholders
* Intrapreneurship
* Increasing products and services
 | * Observation
* Case studies
* Individual/group assignments
* projects
* Written
* Oral
 |
| 1. Undertake county/ regional business expansion
 | * Region/ county identification process
* Regional/ county laws and regulation
* Business regional/county expansion
* Regional/ County business expansion
* Innovation in business
* Business expansion and diversification
* Resources for regional/county expansion
* Business 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/IPOM/BC/02/6/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 competencies for exuding self-awareness and ability to deal with everyday life challenges; demonstrating critical safe work habits and leading a workplace team; planning and organizing work activities; applying learning, creativity and innovativeness in workplace functions; pursuing professional growth and managing time effectively in the workplace.

**SUMMARY OF LEARNING OUTCOMES**

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

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

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

**Suggested Methods of Delivery**

* Instructor lead facilitation of theory
* Demonstrations
* Simulation/Role play
* Group Discussion
* Presentations
* Projects
* Case studies
* Assignments

**Recommended Resources**

* Computers
* Stationery
* Charts
* Video clips
* Audio tapes
* Radio sets
* TV sets
* LCD projectors

## ENVIRONMENTAL LITERACY

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

## ENGINEERING MATHEMATICS

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

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

This unit addresses the unit of competency: Apply mathematical skills

**DURATION OF UNIT:** 144 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, trigonometry and hyperbolic functions, complex numbers, coordinate geometry, binomial expansion, calculus, ordinary differential equations, laplace transforms, power series, Statistics, Fourier series, vector theory, matrix, numerical methods, probability, commercial calculations, estimations and measurements in solving problems

**SUMMARY OF LEARNING OUTCOMES**

1. Apply Algebra
2. Apply Trigonometry and hyperbolic functions
3. Apply complex numbers
4. Apply Coordinate Geometry
5. Carry out Binomial Expansion
6. Apply Calculus
7. Solve Ordinary differential equations
8. Apply Laplace transforms
9. Apply Power Series
10. Apply Statistics
11. Apply Fourier Series
12. Apply Vector theory
13. Apply Matrix
14. Apply Numerical methods
15. Apply concept of probability for work
16. Perform commercial calculations
17. Perform Estimations, Measurements and calculations of quantities

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

|  |
| --- |
| **IIPOM CURRICULUM** |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * 1. Apply Algebra
 | * Base and Index
* Law of indices
* Indicial equations
* Laws of logarithm
* Logarithmic equations
* Conversion of bases
* Use of calculator
* Reduction of equations
* Solution of equations reduced to quadratic form
* Solutions of simultaneous linear equations in three unknowns
* Solutions of problems involving AP and GP
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * 1. Apply Trigonometry and hyperbolic functions
 | * Half -angle formula
* Factor formula
* Trigonometric functions
* Parametric equations
* Relative and absolute measures
* Measures calculation
* Meaning of hyperbolic equations
* Properties of hyperbolic functions
* Evaluations of hyperbolic functions Hyperbolic identities
* Osborne’s Rule
* Ashx+bshx=C equation
* One-to-one relationship in functions
* Inverse functions for one-to-one relationship
* Inverse functions for trigonometric functions
* Graph of inverse functions
* Inverse hyperbolic functions
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * 1. Apply complex numbers
 | * Meaning of complex numbers
* Stating complex numbers in numbers in terms of conjugate argument and
* Modulus
* Representation of complex numbers on the Argand diagram
* Arithmetic operation of complex numbers Application of De Moivre’s theorem
* Application of complex numbers to engineering
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| * 1. Apply Coordinate Geometry
 | * Polar equations
* Cartesian equation
* Graphs of polar equations
* Normal and tangents
* Definition of a point
* Locus of a point in relation to a circle
* Loci of points for given mechanism
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * 1. Carry out Binomial Expansion
 | * Binomial theorem Power series using binomial theorem Roots of numbers using binomial theorem.
* Estimation of errors of small changes using binomial theorem.
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * 1. Apply Calculus
 | * Meaning of derivatives of a function
* Differentiation from fist principle
* Tables of some common derivatives
* Rules of differentiation
* Rate of change and small change
* Stationery points of functions of two variables
* Meaning of integration
* Indefinite and definite integral
* Methods of integration application of integration.
* Integrals of hyperbolic and inverse functions
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * 1. Solve Ordinary differential equations
 | * Types of first order differential equations
* Formation of first order differential equation
* Solution of first order differential equations
* Application of first order differential equations
* Formation of second order differential equations for various systems
* Solution of second order differential equations
* Application of second order differential equations
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * 1. Apply Laplace transforms
 | * Meaning of Laplace transforms deriving Laplace transforms from first principles
* State properties of Laplace transform
* Determination of inverse LT of simple transforms and partial fractions
* Solution of differential equation by LT
* Solution of simultaneous differential equation by given initial conditions
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * 1. Apply Power Series
 | * Meaning of the term power series
* Taylor’s theorem
* Deduction of Maclaurin’s theorem to obtain power series
* Application of Taylor’s theorem and Maclaurin’s theorems in numerical work
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * 1. Apply Statistics
 | * Classification of data

Grouped dataUngrouped data* Data collection
* Tabulation of data

Class intervalsClass boundariesFrequency tables* Diagrammatic and graphical presentation of data e.g.

HistogramsFrequency polygonsBar chartsPie chartsCumulative frequency curves* Measures of central tendency mean, mode and median
* Measures of dispersion

Variance and standard deviation* Definition of probability
* Laws of probability
* Expectation variance and S.D.
* Types of distributions
* Mean, variance and SD of probability distributions
* Application of probability distributions
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
* Simulation
* Data modelling
 |
| * 1. Apply Fourier Series
 | * Determination of the Fourier series as a periodic function of the period 2π and extend to π
* Determination of Fourier series of non-periodic functions over a given range
* Determination of Fourier series for even and odd functions and the half-range series for a given function
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| * 1. Apply Vector theory
 | * Definition of dot and cross product of vectors
* Solution of problems involving dot and cross production of cross
* Definition of operators
* Definition of vector field
* Solutions of problems involving vector fields
* Definition of Gradient, Divergence and curl
* Solutions of involving Gradient, Divergence and curl
* Application of vectors
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| * 1. Apply Matrix methods
 | * Matrix operation
* Determinant of 3x3 matrix
* Inverse of 3x3 matrix
* Solutions of linear simultaneous equations in three unknowns
* Application of matrices
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| * 1. Apply Numerical methods
 | * Meaning of interpolation and extrapolation
* Application of interpolation
* Application of interactive methods to solve equations
* Application of interactive methods to areas and volumes
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 1. Apply concepts of probability in work
 | * + Meaning of probability
	+ Types of probability events
* Dependent
* Independent
* Mutually exclusive
	+ Laws of probability
	+ Counting techniques
* Permutation
* Combination
* Tree diagrams
* Venn diagrams
 | * 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
 |
| 1. Perform estimations, measurements and calculations of quantities
 | * Units of measurements and their symbols
* Conversion of units of measurement
* Calculation of length, width, height, perimeter, area and angles of figures
* Measuring tools and equipment
* Performing measurements and estimations of quantities
 | * Assignments
* Oral questioning
* Practical tests
* Observation
* Supervised exercises
* Written tests
 |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

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

## ELECTRICAL PRINCIPLES

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

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

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

**DURATION OF UNIT:** 96 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 of the concept of basic electrical quantities, use of the concepts of D.C and A.C circuits in electrical installation, use of basic electrical machine, use of power factor in electrical installation, use of earthing in electrical installations, apply lightning protection measures, apply electromagnetic field theory, apply electrodynamics, apply energy and momentum in electromagnetic field, apply transient in electrical circuit analysis, use two port network.

**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 installation
6. Apply lightning protection measures
7. Apply Electromagnetic field theory
8. Apply Electrodynamics
9. Apply Energy and momentum in Electromagnetic field
10. Apply Transient in Electrical circuit analysis

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + 1. Use the concept of basic Electrical quantities
 | * The meaning of SI unit
* SI unit of various types of Electrical parameters
* Ohm’s law
* Calculations involving various Electrical parameters e.g. Power, Current, Voltage, Resistance
* Instruments used in measuring various types of Electrical parameters
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * + 1. Use the concepts of D.C and A.C circuits in electrical installation
 | * Meaning of terms
* AC and DC, parallel and series circuits
* AC and DC network theorems
* AC to DC and DC to AC Conversion
* Basic solar photovoltaic systems
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * + 1. Use of basic electrical machine
 | * Types of Electrical machines
* DC machines,
* AC Single and three phase motors, generators and Transformers
* Motor starting methods e.g.
* DOL
* Star-Delta
* Auto-transformer
* Resistance starter
* Shaded pole
* Split phase
* Capacitor start
* Capacitor Start and run
* Face plate Starting
* Application of AC and DC machines
* Special machines and their Applications
* Electric Drives
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
* Practical tests
 |
| * + 1. Demonstrate understanding of three phase power supply
 | * Meaning of Terms
* Three phase power supply connection
* Star connection
* Delta connection
* Voltage, Current and power calculation
* Measurements of power
* Wattmeter methods
* Interconnection of three phase power supply
* Star- Delta and Delta- Star
 | * Assignments
* Oral questioning
* Practical tests
* Observation
* Written test
 |
| * + 1. 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 tests
 |
| * + 1. Use of earthing in Electrical installations
 | * + Terms in Earthing
	+ Earthing points in Electrical installation
	+ Methods of earthing
	+ Factors to consider in selecting an earthing method
	+ Testing an earthing system
 | * Assignments
* Supervised exercises
* Written tests
* Practical test
 |
| * + 1. Apply lightening protection measures
 | * + Meaning of lightening
	+ Lightening strokes and their types
	+ Lightening protection components
	+ Testing a lightening system
	+ Application of lightening system
	+ Maintenance of lightening system
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| * + 1. Apply Electromagnetic field Theory
 | * + Meaning of Electromagnetic Field Theory
	+ Sources of Electromagnetic Fields
	+ Detectors of Electromagnetic radiation
	+ Application of Electromagnetic waves
	+ Electromagnetics Laws
* Faraday’s Law
* Lenz’s law
* Fleming’s Laws
* Properties and Effects of Electromagnetic waves
* Wave Characteristics and Shielding
* Skin Effect
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| * + 1. Apply Electrodynamics
 | * + Meaning of Electrostatics
	+ Identification of Electrostatic terms and their meaning
	+ Meaning of terms in magnetostatics
	+ Electrodynamics laws

Faraday’s law | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| * + 1. Apply Energy and Momentum in Electromagnetic field
 | * + Energy conservation theorem:
* Poyntings’ Theorem
* Momentum Energy Flow
* Electromagnetic Energy flow
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| * + 1. 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 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/IPOM/CC/03/6/A**

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

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

**DURATION OF UNIT:** 144 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, pictorial and orthographic drawings of components and application of Computer Aided Design (CAD) packages.

**SUMMARY OF LEARNING OUTCOMES**

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

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

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Use and maintain drawing equipment and materials
 | * Identification and care of drawing equipment
* Identification and care of drawing materials
* Reference to manufacturer’s instructions and work place procedures on use and maintenance of drawing equipment and materials
* Reference to relevant environmental legislations
* Use of Personal Protective Equipment (PPEs)
 | * Observation
* Oral questioning
* Written tests
 |
| 1. Produce plane geometry drawings
 | * Types of lines in drawings
* Construction of geometric forms e.g. squares, circles
* Construction of different angles
* Measurement of different angles
* Bisection of different angles and lines
* Standard drawing conventions
 | * 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 pictorial drawings
 | * Meaning of pictorial drawings
* Drawing objects in isometric view
* Drawing objects in oblique view
 | * Observation
* Oral questioning
* Practical tests
 |
| 1. Produce electrical drawings
 | * Electrical symbols and abbreviations
* Meaning of electrical drawings
* Drawing of electrical diagrams e.g. block, schematic, circuit, line and wiring
 | * Observation
* Oral questioning
* Practical tests
 |
| 1. Apply CAD packages
 | * Identification of CAD packages e.g. AutoCAD, circuit maker
* Use of CAD packages in drawing of:
* Plane geometry
* Solid
* Orthographic
* Pictorial
* Electrical e.g. block, schematic, circuit, line and wiring
 | * 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

## MECHANICAL SCIENCE PRINCIPLES

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

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

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

**DURATION OF UNIT:** 96 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

## FLUID MECHANICS PRINCIPLES

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

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

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

**DURATION OF UNIT:** 96 hours

**UNIT DESCRIPTION**

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

**SUMMARY OF LEARNING OUTCOMES**

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

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

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

**Suggested Delivery Methods**

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

**Recommended Resources**

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

## THERMODYNAMICS PRINCIPLES

**UNIT CODE: ENG/CU/IPOM/CC/6/A/6/A**

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

This unit addresses the unit of competency: Apply thermodynamics principles

**DURATION OF Unit:** 96 hours

**UNIT DESCRIPTION**

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

**SUMMARY OF LEARNING OUTCOMES**

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

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

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

**Suggested Delivery Methods**

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

**Recommended Resources**

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

## METALLURGICAL PROCESSES AND MATERIAL SCIENCE

**UNIT CODE: ENG/CU/IPOM/CC/07/6/A**

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

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

**DURATION OF UNIT:** 96 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

##

# CORE UNITS OF LEARNING

## OPERATING AND MAINTAINING INDUSTRIAL BOILERS

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

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

The unit addresses the unit standard: Maintain and Operate an Industrial boilers.

**DURATION OF UNIT:** 160 hours

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by a boiler mechanical technician in order to competently and safely overhaul and service boiler components/ equipment.

**SUMMARY OF LEARNING OUTCOMES**

1. Apply industrial boiler operations and maintenance
2. Identify industrial boiler parts
3. Start Industrial boiler
4. Monitor and control industrial boiler performance
5. . Conduct industrial boiler diagnostic tests and identify faults
6. Perform industrial boiler service and /repair
7. Re-commission industrial boiler operations
8. Stop industrial boiler
9. Perform housekeeping procedures
10. Document and update maintenance records

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

|  |  |  |
| --- | --- | --- |
|  **Learning outcomes**  | **Content**  | **Suggested assessment methods**  |
| 1. Apply industrial boiler operations and maintenance
 | * Develop safety plan for boiler
* Occupational safety and health act (osha) requirements
* Personal safety gear
* Environment conservation requirements
* Work environment safety
* Avoid water hammer
* Observation of warning labels, barriers and signs
 | * Written assessment
* Observation
* Oral
 |
| 1. Identify industrial boiler parts
 | * + Operation principle of a boiler
	+ Definition of terms
	+ Types of boilers
* Babcock and wagon top boilers
* Cylindrical fire tube boiler
* Multi tube boilers
* Solid fuel firing
* Fire tube boilers
* Water tube boilers
* Super heater
	+ Components of a boiler
* Feed water heaters
* Fuel heater
* Deaerators
* Pumps
* Combustion air blowers
* Flue
* Economizers
* Steam traps
* Piping
* Shell
* Control system
 | * Written assessment
* Observation
* Oral
 |
| 1. Start the boiler
 | * Opening of the vent valve to release pressure
* Closing of steam outlet valve
* Opening of fuel line and circulating of the fuel to attain recommended temperature
* Feeding water into the boiler until the minimum level
* Ignition of the fuel and starting the boiler in automatic mode
* Observation of the flame size and color
* Closing of the vent valve when steam starts venting
* Opening of the main valve to distribute steam to the plant
 | * Written assessment
* Observation
* Oral
 |
| 1. Monitor and control industrial boiler performance
 | * Monitoring of temperature
* Fuel level monitoring
* 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
* Pressure and steam quality monitoring
 | * Written assessment
* Observation
* Oral
 |
| 1. Conduct industrial boiler diagnostic tests and identify 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 deaerator and water level alarm switches 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 assessment
* Observation
* Oral
 |
| 1. Perform industrial boiler service and / repair
 | * Adherence to recommended maintenance plan to repair time standards
* Performance of repairs and replacement of faulty parts
* Types of maintenance
* Annual maintenance
* Inspection and cleaning of fireside surfaces
* Inspection of burner refractory materials
* Inspection of manhole gaskets
* Inspection and testing of all safety valves
* Calibration of all operation controls
* Overhaul of feed water pumps
* Inspection of electrical terminals and control
* Inspection of tubes for leakages
* Periodic maintenance
* Cleaning of oil filters
* Cleaning of air filters
* Cleaning of sight glasses
* Conducting of boiler blowdown to sludge and sediments
 | * Written assessment
* Observation
* Oral
 |
| 1. Re-commission industrial boiler operations
 | * Testing of boiler functionality
* Air leakage test
* Boiler hydro test
* Refractory dryness
* Gas distribution tests
* Safety valve test
* Readiness of boiler auxiliaries
* Boiler light up test
* Main fuel firing/lighting
 | * Written assessment
* Observation
* Oral
 |
| 1. Stop industrial boiler
 | * Stopping the boiler automatic cycle
* Closing of steam stop valve
* Closing of boiler feed water valves
* Open of vent valve
 | * Written assessment
* Observation
* Oral
 |
| 1. Perform housekeeping procedures
 | * Workplace cleanliness and organization
* Job shop organization
 | * Written assessment
* Observation
* Oral
 |
| 1. Document and update maintenance records
 | * Report writing procedure
* Maintenance scheduling
* Updates and storage of maintenance records
 | * Written assessment
* Observation
* Oral
 |

## OPERATING AND MAINTAINING INDUSTRIAL STEAM TURBINES

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

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

The unit addresses the unit standard: Maintain and Operate Industrial Steam Turbine.

**DURATION OF UNIT:** 160 hours

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by a steam turbine mechanical technician in order to competently and safely overhaul and service boiler components/ equipment.

**SUMMARY OF LEARNING OUTCOMES**

1. Apply Steam Turbine Operations and Maintenance
2. Identify Industrial Steam Turbine Parts
3. Start Industrial Steam Turbine parts
4. Monitor and Control Industrial Steam Turbine Performance
5. Conduct industrial steam turbine diagnostic tests and identify faults
6. Perform industrial steam turbine service and or/ Repair
7. Conduct industrial steam turbine pretest procedures
8. Stop industrial turbine
9. Perform housekeeping procedures
10. Document and update maintenance records

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| 1. Apply Steam Turbine Operations and Maintenance Safety Procedures
 | * + Develop safety plan for Steam Turbine
	+ Occupational safety and health act (OSHA) requirements
* Personal safety gear
* Environment conservation requirements
* Work environment safety
	+ Avoid water hammer
	+ Observation of warning labels, barriers and signs
 | * Written assessment
* Observation
* Oral
 |
| 1. Identify Industrial Steam Turbine parts
 | * + Operation principle of a steam turbine
	+ Definition of terms
	+ Types of steam turbines
* Impulse
* Reaction
	+ Components of a steam turbine
* Rotor
* Stator/ Diaphragm
* Blades
* Bearings
* Valves
* Seals
* Casing
 | * Written assessment
* Observation
* Oral
 |
| 1. Start Industrial Steam Turbine
 | * + Check steam inlet parameters
	+ Admission of steam into the turbine
	+ Hold speed, check vibrations and lube oil pressures
	+ Ramp the turbine to full speed while observing the parameters
	+ Connect to the load
	+ Continue monitoring
 | * Written assessment
* Observation
* Oral
 |
| 1. Monitor and Control Industrial Steam Turbine Performance
 | * + Monitoring of speed
	+ Monitoring of vibrations
	+ Monitoring of lube oil
	+ Monitoring of temperature
 | * Written assessment
* Observation
* Oral
 |
| 1. Conduct industrial Steam Turbine diagnostic tests and Identify Faults
 | * + Testing of Industrial Steam turbine alarm systems
	+ Carry out Periodic noise levels tests
	+ Conduct Pre-operational checks
	+ Check Exhaust steam discharge valves for function ability
	+ Check Non-drive end and drive-end bearing temperatures using infra-red thermometer and recorded in the log book
 | * Written assessment
* Observation
* Oral
 |
| 1. Perform industrial Steam turbine service and or/ repair
 | * Servicing of Water Strainers (online and standby)
* Adherence to Maintenance schedule
* Servicing of Speed governors
* Fixing Tube / pipe leaks
* Fixing Oil leaks
* Performing Vacuum cleaning on the steam turbine panels
 | * Written assessment
* Observation
* Oral
 |
| 1. Re-commission industrial Steam Turbine Operations
 | * Industrial Steam Turbine start-up procedures
* Warm start-up
* Cold start-up
* Testing of industrial Steam Turbine
* Steam blowing
* Condenser test
* Readiness of steam turbine
* Bearing clearance
* Float
* Dump of rotor
* Gear and pinion
* Throttle valve setting
* Safety trip functioning and response of SEV
 | * Written assessment
* Observation
* Oral
 |
| 1. Stop Industrial Steam Turbine
 | * Stopping of steam turbine
* Engaging of turning gear
* Drains of steam in turbine
* SEV drain
* Nozzle chest drain
* Wheel case drain
* Casing drain
* Throttle valve drain
* Steam isolation valves
* Breaking of condenser vacuum
* Cooling steam turbine
 | * Written assessment
* Observation
* Oral
 |
| 1. Perform Housekeeping Procedures
 | * Workplace cleanliness and organization
* Job shop organization
 | * Written assessment
* Observation
* Oral
 |
| 1. Document and Update Maintenance Records
 | * Report writing procedure
* Maintenance scheduling
* Updates and storage of maintenance records
 | * Written assessment
* Observation
* Oral
 |

## OPERATING AND MAINTAINING INDUSTRIAL HYDRAULICS SYSTEMS

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

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

The unit addresses the unit standard: Maintain and Operate Industrial Hydraulic Systems

**DURATION OF UNIT:** 128 hours

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by a Hydraulic system technician in order to competently and safely overhaul and service hydraulic system components.

**SUMMARY OF LEARNING OUTCOMES**

1. Apply industrial hydraulic systems operations and maintenance safety procedures
2. Identify industrial hydraulic system parts
3. Run industrial hydraulic system
4. Conduct Industrial Hydraulic System Diagnostic test and Identify Faults
5. Perform industrial hydraulic system service and or/ repair
6. Perform housekeeping procedures
7. Document and update maintenance records

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

| **Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| --- | --- | --- |
| 1. **Apply industrial hydraulic systems operations and maintenance safety procedures**
 | * Develop safety plan for Steam Turbine
* Occupational safety and health act (OSHA) requirements
* Personal safety gear
* Environment conservation requirements
* Work environment safety
* Avoid water hammer
* Observation of warning labels, barriers and signs
 | * Written assessment
* Oral
* Observation
 |
| 1. **Identify industrial hydraulic system parts**
 | * + Operation principle of industrial hydraulic system parts
	+ Definition of terms
	+ Types of hydraulic pumps
* Gear pumps
* Hydraulic piston pumps
* Gerotor pumps
* Screw pumps
* Bent axis hydraulic pumps
* Axial piston pumps
* Radial piston pumps
	+ Components of industrial hydraulic system
* Hydraulic liquids
* Sealing devices
* Reservoirs and Accumulators
* Pumps
* Control Valves
* Actuators and Cylinders
 | * Written assessment
* Oral
* Observation
 |
| 1. **Run industrial hydraulic system**
 | * Cleanliness of hydraulic equipment
* Hydraulic filters replacement
* Hydraulic fluid replacement
* Hydraulic component testing
* Dynamic testing
* Static testing
 | * Written assessment
* Oral
* Observation
 |
| 1. **Conduct industrial hydraulic system diagnostic test and identify**
 | * Testing of Industrial hydraulic system alarms
* Pump inlet strainer test
* Pump test
* Relief valve test
* Cylinder test
* Directional valve
 | * Written assessment
* Oral
* Observation
 |
| 1. **Perform industrial hydraulic system service and or/ repair**
 | * Perform 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
* Re-assemble the system
* Confirm the operating parameters
* Update Inventory
* Update Maintenance Log
 | * Written assessment
* Oral
* Observation
 |
| 1. **Perform housekeeping procedures**
 | * Workplace cleanliness and organization
* Job shop organization
 | * Written assessment
* Oral
* Observation
 |
| 1. **Document and update maintenance records**
 | * Report writing procedure
* Maintenance scheduling
* Updates and storage of maintenance records
 | * Written assessment
* Oral
* Observation
 |

## OPERATING AND MAINTAINING INDUSTRIAL PNEUMATIC SYSTEMS

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

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

The unit addresses the unit standard: Maintain and Operate Industrial Pneumatic Systems

**DURATION OF UNIT:** 128 hours

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by a Pneumatic system technician in order to competently and safely operate, overhaul and service hydraulic system components.

**SUMMARY OF LEARNING OUTCOMES**

1. Apply Industrial Pneumatic Systems Operations and Maintenance Safety Procedures
2. Identify Industrial Pneumatic System Parts
3. Run Industrial Pneumatic System
4. Conduct Industrial Pneumatic System Diagnostic test and Identify Faults
5. Perform industrial Pneumatic system Service and or/ Repair
6. Perform Housekeeping procedures
7. Document and Update Maintenance records

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

| **Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| --- | --- | --- |
| 1. Apply Industrial Pneumatic Systems Operations and Maintenance Safety Procedures
 | * **Identify personal safety gear**
* Correct PPEs
* Helmet
* 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
* **Identify risks and hazards in Pneumatic systems**
* Uncontrolled leakage of the Pneumatic fluid
* Accidental machine movement
* Risk of burning at hot surfaces or hot Pneumatic fluid
* Parts coming off or bursting
* Skin diseases
* Noise
* **Reporting of incidents and accidents**
* Description of incident, accident
* Incident/ accident reporting process
* Incident/ accident report forms
 | * Written
* Oral
* Observation
 |
| 1. Identify Industrial Pneumatic System Parts
 | * Definition of pneumatic systems
* Categories of pneumatic systems

Rotor piston type Reciprocating piston* Examples of pneumatic devices
* Rock drills
* Pavements breakers
* Riveters
* Forging presses
* Paint sprayers
* Blast cleaners
* Forging presses
* Blast cleaners
* Atomizers
* Parts of a pneumatic system
* Compressor
* Reservoir
* Valves
* Actuators
 | * Written
* Oral
* Observation
 |
| 1. Run Industrial Pneumatic System
 | * Operation principle of a pneumatic system
* Running of the compressor to fill reservoir tank
* Opening of valves to allow flow of air to supply lines
* Running the pneumatic system
* Stopping a pneumatic system
* Closing of valves to cut the flow of air
 | * Written
* Oral
* Observation
 |
| 1. Conduct industrial pneumatic system diagnostic test and identify 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
* Oral
* Observation
 |
| 1. Perform industrial Pneumatic system service and /repair
 | * 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
* Oral
* Observation
 |
| 1. Perform housekeeping procedures
 | * Remove dirt, rubbish
* Clean off spilled oil
* Perform procedures for general housekeeping
 | * Written assessment
* Observation
* Oral
 |
| 1. Document and update Maintenance Records
 | * Report writing procedure
* Maintenance scheduling
* Updates and storage of maintenance records
 | * Written assessment
* Observation
* Oral
 |

## MAINTAINING INDUSTRIAL PUMPS

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

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

The unit addresses the unit standard: Service and Maintain Industrial Pumps

**DURATION OF UNIT:** 128 hours

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by a hydraulic pump technician in order to competently and safely overhaul and service Industrial pump

**SUMMARY OF LEARNING OUTCOMES**

1. Apply Industrial Pumps Maintenance Safety Procedures
2. Identify Industrial Pump Components
3. Conduct Industrial Pump Diagnostic test and Identify Faults
4. Perform industrial pumps Service and or/ Repair
5. Perform Housekeeping procedures.
6. Document and Update Maintenance records

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| 1. Apply Industrial Pumps 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
* Oral
* Observation
 |
| 1. Identify Industrial pump Components
 | * Definition of terms
* Working principle of pumps
* Types of industrial pumps
* Centrifugal pumps
* Axial flow
* Radial flow
* Mixed flow
* Positive displacement pumps
* Reciprocating pump
* Rotary pumps
* Components of industrial pumps
* Housing
* Impeller
* Motor
* Shaft
* Volute
* Bearing assembly
* Hub
* Seals
* Controllers
* Fittings and adapters
* Mounting devices
 | * Written
* Oral
* Observation
 |
| 1. Conduct Industrial pump diagnostic test and identify faults
 | * Checking for vibration or overheating
* Checking for priming failure
* Checking for leakage of seals
* Checking usage of excessive power
* Checking for pressure quantity
* Checking for pump ceasing
 | * Written
* Oral
* Observation
 |
| 1. Perform industrial pumps Service and or/ Repair
 | * Identification of Cracks *through dye penetrant* methods within the volute casing and pedestral foundation
* Servicing and or replacement of Seals, O-rings, glands, main shafts, impeller lock nuts, impeller, both drive-end and non-drive -end *bearings*
* Carrying out (Static) *Impeller balancing* according to SOPs
* Restoring *all clearances and tolerances to the manufacture’s* specifications
* Identification of Right lubrication (food grade or non-food grade)
* Scheduling for Pumps next due date for service and update the check card and pump schedule
 | * Written
* Oral
* Observation
 |
| 1. Perform House Keeping Operations
 | * Disposing any damaged/ worn components and used up fluids appropriately
* Returning unused fluids or components to store
* Carrying out basic visual safety inspection of work area
* Cleaning up any spills in work area
* Returning any PPE used
 | * Written
* Oral
* Observation
 |
| 1. Reporting and Documentation
 | * Updating inventory
* Updating maintenance schedule for pumps
* Updating daily check cards
 | * Written
* Oral
* Observation
 |

## MAINTAINING INDUSTRIAL STEAM DISTRIBUTION LINE

**UNIT CODE: ENG/CU/IPOM/CR/6/A/6/A**

**RELATIONSHIP TO OCCUPATIONAL STANDARDS**

The unit addresses the unit standard: Service and Maintain Industrial Steam Distribution Lines

**DURATION OF UNIT:** 160 hours

**UNIT DESCRIPTION**

The unit describes the skills, knowledge and attitudes required by a hydraulic Steam Distribution Line technician in order to competently and safely overhaul and service Industrial Steam Distribution Lines

**SUMMARY OF LEARNING OUTCOMES**

1. Apply Industrial Steam Distribution Line Safety Procedures
2. Identify Steam Distribution Line Components
3. Conduct Steam Distribution Line Diagnostic test and Identify Faults
4. Perform Steam Distribution Line Service and or/ Repair
5. Perform Housekeeping Procedures
6. Document and Update Maintenance records

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

|  |  |  |
| --- | --- | --- |
|  **Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| 1. Apply Industrial Steam Distribution Line Safety Procedures
 | * **Identification of personal safety gear**
* Helmet
* Ear muffs
* 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
* Potential Hazards Identification and Recording
* Identifying ways of eliminating and controlling the hazards
* Permit to Work Records
 | * Written
* Oral
* Observation
 |
| 1. Identify Steam Distribution Line Components
 | * **Identification of Components in Industrial Steam Distribution Lines and their Functions**
	+ Steam traps
	+ Steam separators
	+ Steam pipes
	+ Drain points Strainer and filters
	+ Air vents
	+ Pressure reducing valves
	+ Expansion joint
	+ Flow counters
	+ Condensate recovery system
	+ Valves
	+ Pressure gauges
	+ Flowmeters
 | * Written
* Oral
* Observation
 |
| 1. Conduct Steam Distribution Line Diagnostic test and Identify Faults
 | * **Identification of potential failures, symptoms and indicators of failure in Steam Distribution Lines**
* Leakages – Traps, Bents and Joints
* Burst pipes
* Blocked air vents, strainers and filters
* Loose valves
* Loose connection points
* **Identification of risks and hazards in Steam Distribution Line systems**
* Asbestos lagging
* Thermal hazards
* Manual handling hazards
* Leakage of steam
* Fumes from a liquid chemical spill
* Faulty/broken ladder or hand rail
* Flammable liquids
* Fire and explosion
* Electrical hazards
* Identification of cracks ***through dye penetrant/ or other*** methods within the volute casing and pedestal foundation according to SOPs
* Tagging of Leakages and generation of reports
* Using thickness tester to identify the areas of wear and tear
* Servicing of Steam traps as per the SOPs
* Checking of Valve seats and valve landings at the headers as per SOP
* Identification and classification of Steam line bolts and nuts
* Identification and classification of steam line pipes and bends
* Adjusting the bolts joining steam line flanges regularly and spraying using penetrating oil as per SOPs
* Updating the Total length of all various diameters of steam line in the inventory
* Generating reports and records as necessary
 | * Written
* Oral
* Observation
 |
| 1. Perform Steam Distribution Line Service and or/ Repair
 | * Identification of resources to be used in the job
* Assessment of all hazards involved in the job and filling of Permit to Work Forms and getting them authorized
* Performing all isolations and putting Lock Out Tags where necessary
* Performing of the Service/Repair Job as per Operating Procedure
* Boxing Up the line and performing of conformance tests
* Commissioning the line and removing all Lock Outs and cancel Permit To work form
 | * Written
* Oral
* Observation
 |
| 1. Perform Housekeeping Procedures
 | * Disposing off any damaged/ worn-out components in the designated bins
* Returning of unused components to store
* Carrying out basic visual safety inspection of work area
* Cleaning up of any spills in work area
 | * Written
* Oral
* Observation
 |
| 1. Document and Update Maintenance records
 | * Preparing a template for data collection before execution of the tasks
* Collecting the data as the tasks are carried out
* Reviewing of Logs books, daily check charts and Steam Distribution Line reports
* Generation of Working check card for Steam Distribution Line
* Analyzing and evaluation of the data to generate value adding reports
 | * Written
* Oral
* Observation
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