REPUBLIC OF KENYA

COMPETENCY BASED CURRICULUM

FOR

ELECTROTECHNICAL ENGINEERING

LEVEL 6

CU ISCED CODE: 0714 554 A

TVET CDACC
P.O BOX 15745-00100
NAIROBI

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Council Secretary/CEO
TVET Curriculum Development, Assessment and Certification Council
P.O. Box 15745–00100
Nairobi, Kenya
Email: info@tvetcdacc.go.ke

FOREWORD

Provision of quality education and training is fundamental to the Government's overall strategy for social economic development. Quality education and training contributes 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. Alignment of the education sector to the Constitution 2010 resulted to the formulation of Sessional Paper No. 1 of 2019 on Policy Framework for Reforming Education and Training for Sustainable Development. A key feature of this policy is the paradigm shift in the design and delivery of Technical and Vocational Education and Training (TVET). The 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 allowing for multiple entry and exit into TVET programmes.

The reforms demand that industry takes a leading role and informs curriculum development to ensure the curriculum addresses industry competence needs. It is against this background that this Curriculum has been developed to address the skill gaps in the marine industry.

It is my conviction that this curriculum will play a great role towards development of competent human resource for sustainable growth and development in the Maritime Sector.

Dr. Esther Thaara Mworia, Phd
Principal Secretary
State Department for Technical and Vocational Education and 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 the rapidly industrializing economy through training and life-long learning. The TVET sector has a responsibility of facilitating the process of acquisition of knowledge, skills and attitudes necessary for transforming the nation to a globally competitive country, hence the paradigm shift to Competency Based Education and Training (CBET).

The TVET Act Cap 210A is a product of Reforms in Education and Training in Kenya; the Sessional Paper No. 1 of 2019 specifically emphasizes the need for reform in curriculum design, development, assessment and certification. Hence, the shift to CBET to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labour force.

The development of this curriculum was through the collaborative effort of the TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) and the Kenya Maritime Authority and Maritime Sector Skills Advisory Committee (SSAC).
This curriculum has been developed in line with the International Maritime Organization (IMO), STCW Standards 2010, CBETA Standards and Guidelines 2023; the Kenya National Qualification Framework (KNQF) and TVET CDACC Curriculum Development Framework.
The curriculum is designed and organized with an outline of learning outcomes; suggested delivery methods, training/learning resources and methods of assessing the trainee's achievement.
I am grateful to the Kenya Maritime Authority, Maritime SSAC, expert marine trainers and all those who participated in the development of this curriculum.

Prof. Ahmed Ferej
Chairman, TVET CDACC

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ACKNOWLEDGMENT

The development of this Competency Based Curriculum incorporated the standards of competence provided in the International Convention on Standards of Training, Certification and Watchkeeping (STCW) 1978; amended in 2010 in accordance with the requirements of the Merchant Shipping (Training and Certification) Regulations and the Seafarers' Code of Qualification (COQ).

This curriculum design adopted the competency-based training approach with independent units of learning to allow for flexibility in the trainee entry and exit into the programme. I acknowledge the significant involvement and support received from various organizations in the development of this curriculum.

I wish to recognize and appreciation the valuable input and support of the staff from Kenya Maritime Authority (KMA) and the Maritime Sector Skills Advisory Committee (SSAC) in the development of this curriculum and ensuring that the required competencies in the Maritime industry were addressed in the curriculum. I also thank other stakeholders, specifically the trainers in the maritime sector for their valuable input and all those who participated in the process of development of this curriculum.

I am convinced that this curriculum will go a long way in ensuring that workforce in the maritime sector acquire required competencies to enable them effectively perform their work.

Prof. Kisilu Kitainge
Council Secretary/CEO
TVETCDACC

TABLE OF CONTENT

ABBREVIATIONS AND ACRONYMS

CBET	Competency Based Education and Training
CDACC	Curriculum Development Assessment Certification Council
CEO	Council Secretary
OS	Occupational Standard
OSH	Occupational Safety and Health
TVET	Technical and Vocational Education and Training
KMA	Kenya Maritime Authority
DG	Director General
STCW	The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978 as amended
IMO	International Maritime Organization
2D	Two Dimension
3D	Three Dimension
DC	Direct Current
AC	Alternate Current
PLC	Programmable Logic Controller
PID	Proportional Integral Derivative Controller
RL	Resistor Inductor
RC	Resistor Capacitor
RLC	Resistor Inductor Capacitor
VHF	Very High Frequency
ISDN	Integrated Services Digital Network
ICT	Information and Communication Technology
CAD	Computer Aided Design
NURBS	Non-Uniform Rational B-Splines
IAMCS	Integrated Alarm, Monitoring and Control System
HART	Highway Addressable Remote Transducer Protocol
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
JFET	Junction Field Effect Transistor
IGBT	Insulated Gate Bipolar Transistor
MSI	Medium Scale Integration
IGCT	Integrated Gate Commutated Thyristor
SCR	Silicon Controlled Rectifier
GTO	Gate Turn Off thyristor
CB	Circuit Breaker
GFCI	Ground Fault Circuit Interrupter
SOLAS	Safety of Life at Sea
LSIC	large-scale integrated circuit
IC	Integrated Circuit
UMS	unmanned machinery space
WHS	work health and safety

OHS	occupational health and safety
PPE	Personal Protective Equipment
RAC	Refrigeration and Air Conditioning
STCW	Standards of Training, Certification and Watchkeeping for Seafarers
ISM	International Safety Management
MARPOL	International Convention for the Prevention of Pollution from Ships
ISPS	International Ship and Port Facility Security
CG	Center of Gravity
VCG	Vertical Center of Gravity
LCG	Longitudinal Center of Gravity
MATLAB	Matrix Laboratory
SMCP	IMO Standard Marine Communication Phrases
CPU	Computer Processing Unit
RAM	Random access memory
CDs	compact discs
DVDs	digital optical discs
DVI	Digital Visual Interface
HDMI	High-Definition Media Interface ports
VGA	Video Graphics Array
USB	Universal Serial Bus
iOS	iPhone Operating System
ISDN	Integrated Services Digital Network
Apps	Applications
TVs	Television
APT	Advanced persistent threats
DDoS	Distributed denial of service
MitM	Man-in-the-middle attack
IT	Information technology
ICT	information communications technology

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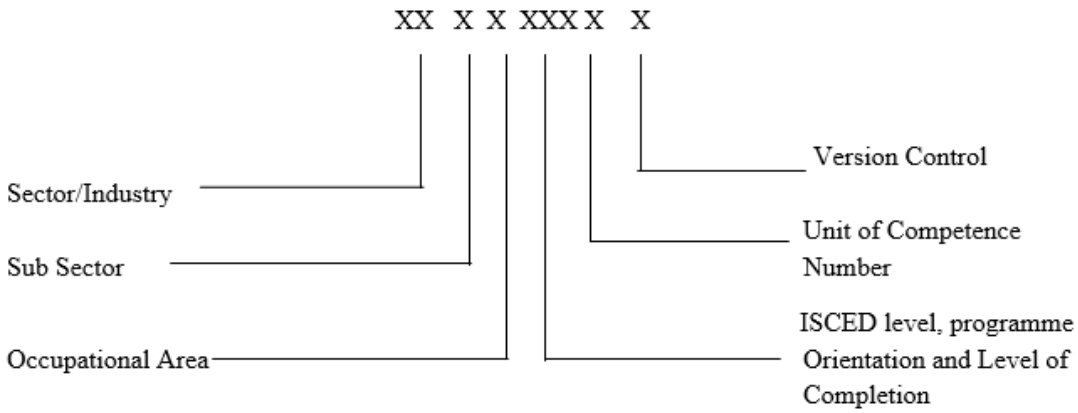
KEY TO UNIT CODE



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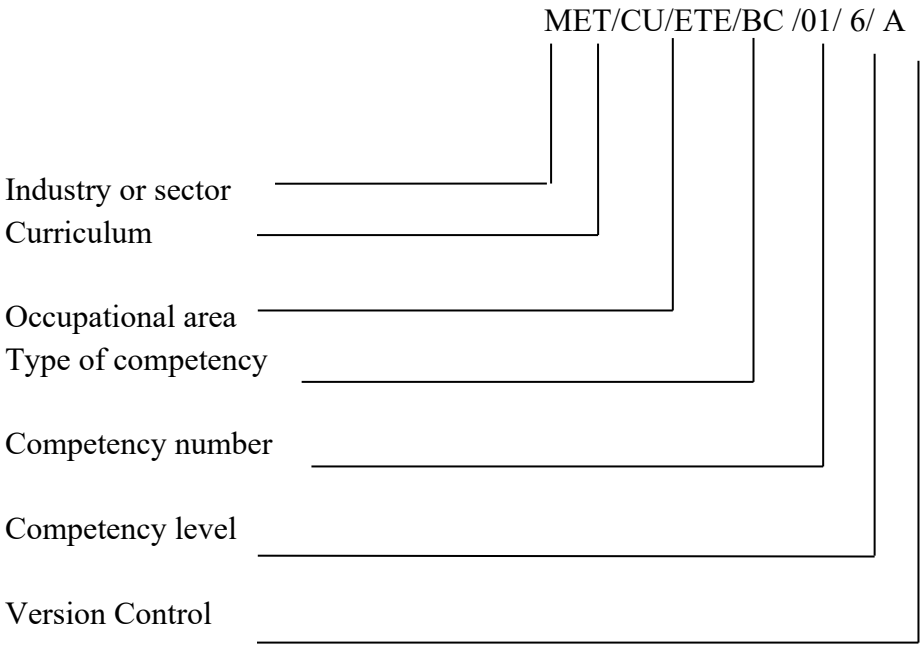

COURSE OVERVIEW

Electro-technical Engineering Level 6 Qualification consists of competences that an individual must have to perform Electrical and Electronic installation works and other duties in the ship's engine room and engineering deck as prescribed in the International Convention Standards of Training, Certification and Watchkeeping for Seafarers (STCW). It entails Operating marine electrical and electronics systems, maintaining marine electrical and electronics systems, Maintaining Emergency Equipment, monitoring control systems of shipboard machinery, operating generators, power distribution and communication systems, maintaining automation and control systems and Maintaining bridge navigation and communication equipment, Deck machinery Electrical, electronics and Control Systems and Hotel Equipment Control and Safety Systems.

This Course consists of the following basic, common and core units of learning:

Basic Units of Learning

Unit Code	TVET CDACC Unit Code	Unit Title	Duration in Hours	Credit Factor
0031 541 01A	MET/CU/ETE/BC /01/6/A	Maritime Communication Skills	30	3
0611 541 02A	MET/CU/ETE/BC /02/6/A	Digital Literacy and Maritime Cyber Security	30	3
0031 541 03A	MET/CU/ETE/BC /03/6/A	Maritime Workplace Essential Skills	30	3
			90	**9**

Common Units of Learning

Unit Code	TVET CDACC Unit Code	Unit Title	Duration in Hours	Credit Factor
0541 541 04A	MET/CU/ETE/CC /01/6/A	Maritime Engineering mathematics	100	10
0732 541 05A	MET/CU/ETE/CC /02/6/A	Engineering Drawing	30	3
0714 541 06A	MET/CU/ETE/CC /03/6/A	Electrical and Electrotechnology Principles	240	24
0716 541 07A	MET/CU/ETE/CC /04/6/A	Ship construction principles	40	4
0715 541 08A	MET/CU/ETE/CC /05/6/A	Thermodynamics principles	30	3

0715 541 09A	MET/CU/ETE/CC /06/6/A	Physical science Principles	60	6
0715 551 10A	MET/CU/ETE/CC /07/6/A	Workshop Practices	100	10
0714 541 11A	MET/CU/ETE/CC /08/6/A	Maritime legislations	40	4
0532 541 12A	MET/OS/ETE/CC /09/6/A	Basic Engineering Science	50	5.0
0531 541 13A	MET/OS/ETE/CC /10/6/A	Industrial Chemistry Principles	40	4.0
Total			**730**	**73**

Core Units of Learning

Unit Code	TVET CDACC Unit Code	Unit Title	Duration in Hours	Credit Factor
0714 551 14A	MET/CU/ETE/CR /01/6/A	Marine Electrotechnology Systems	240	24
0714 551 15A	MET/CU/ETE/CR /02/6/A	Marine Electrical and Electronics Systems Maintenance	120	12
0714 551 16A	MET/CU/ETE/CR /03/6/A	Emergency Equipment Maintenance	50	5
0714 551 17A	MET/CU/ETE/CR /04/6/A	Control Systems of Shipboard Machinery	210	21
0714 551 18A	MET/CU/ETE/CR /05/6/A	Generators, Power distribution and Communication System	240	24
0714 551 19A	MET/CU/ETE/CR /06/6/A	Automation and Control Systems Maintenance	100	10
0714 551 20A	MET/CU/ETE/CR /07/6/A	Bridge Navigation and Communication Equipment Maintenance	60	6
0714 551 21A	MET/CU/ETE/CR /08/6/A	Deck machinery Electrical, electronics and Control Systems Maintenance	60	6
0714 551 22A	MET/CU/ETE/CR /9/6/A	Hotel Equipment Control and Safety Systems Maintenance	30	3.0
		Industrial Attachment	480	48
Total			**1590**	**159**
Grand Total			**2410**	**241.0**

Entry Requirements

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

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

Or

b) Certificate in Electrotechnical Engineering or related Level 5 course

Or

c) Equivalent qualifications as determined by TVET Authority

Trainer qualification-

Qualifications of a trainer for Electro-technical Engineering Level 6 include:

a) Possession of a higher qualification than Electro-technical Engineering level 6 or in related trade area.
b) Licensed by KMA
c) Licensed by TVETA

Industrial Training

A trainee enrolled in this course will undergo an industrial training for a period of at 480 hours in the maritime industry. The mentoring tool should be filled and signed in all sections by both the trainee and the industrial supervisors or their preceptors during attachment period.

Credit Accumulation, Transfer and exemptions

A trainee enrolling in this course may benefit as follows:

a) Credit exception in all basic units of learning for a trainee with KNQF level 5 qualification in related Engineering field.
b) Credit exception in common units of learning for KNQF level 5 qualification in related Engineering field; where the learning outcomes and scope of learning stipulated in the performance criteria are similar.
c) The credit transferred shall account for a maximum of 49% of credits accumulated.
d) There shall be no credit transfer for industrial attachment or core units

Gender and Diversity Inclusion in Training

This curriculum aims to present materials and activities that are respectful of diversity: gender, disability, age, socioeconomic status, ethnicity, race, nationality, religion, and culture.

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Assessment

The course shall be assessed formatively and summatively:

a) During formative assessment all performance criteria shall be assessed based on performance criteria weighting.
b) Summative assessment shall focus more on critical aspects of the Unit of competency.
c) During summative assessment basic and common units shall be integrated or assessed concurrently with the core units.
d) Formative and summative assessment weights shall constitute 60% and 40% of the overall score respectively.
e) Theory and practical weight shall be 40:60 for each unit of learning.
f) For a candidate to be declared competent in a unit of competency, the candidate must meet the following conditions:
    i) Obtained at least 40% in theory assessment in formative and summative assessments.
    ii) Obtained at least 50% in practical assessment in formative and summative assessment where applicable.
    iii) Obtained at least 50% in the weighted results between formative assessment and summative assessment where the former constitutes 60% and the latter 40% of the overall score.
g) Assessment performance rating for each unit of competency shall be as follows:

MARKS	COMPETENCE RATING
80 -100	Mastery
65 - 79	Proficiency
50 - 64	Competent
49 and below	Not Yet Competent
Y	Assessment Malpractice/irregularities

h) Assessment for Recognition of Prior Learning (RPL) may lead to award of Certificate of Competency

Certification

A candidate will be issued with a Certificate of Unit Competency on demonstration of competence in a unit of competency. To be awarded a full qualification in Electro-Technical Engineering evel 6, the candidate must demonstrate competence in all the units of competency as given in qualification pack.

These certificates will be issued by TVET CDACC.

BASIC UNITS OF LEARNING

MARITIME COMMUNICATION SKILLS

ISCED UNIT CODE: 0031 541 01A
TVET CDACC UNIT CODE: MET/CU/ETE/BC /01/6/A

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Apply maritime communication skills

Duration of Unit: 30 Hours

Unit Description

This unit covers the competencies required to demonstrate maritime communication skills. It involves, applying marine communication phrases, using English language in written and oral communication, using internal communication system onboard, executing commands in emergency situations, recognizing existence of cultural and religious diversities in the maritime sector and preparing shipboard report.

Summary of Learning Outcomes

1. Apply marine communication phrases
2. Use English in written and oral communication
3. Use internal communication systems onboard
4. Execute commands in emergency
5. Recognize the existence of cultural and religious diversities in the maritime sector
6. Prepare shipboard reports.

Learning Outcomes, Content, and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply marine communication phrases	● marine communication phrases • Communication procedures: ● Distress ● Search and rescue ● Radio medical advice ● Safety communication ● Urgency communication ● Environmental	● Observation ● Written assessment ● Oral assessment ● Practical assessment

Learning Outcome	Content	Suggested Assessment Methods
	protection • Meteorological and hydrological condition • Navigational warnings • Pilotage • Helicopter operations • Icebreaker operations • Vessel traffic service (VTS)standard phrases • Onboard communication phrase: • Standard helm orders • Standard engine orders • Pilot on the bridge • Handing over watch • Safety onboard • Cargo and cargo handling • Preparing for sea • Passenger care ● Marine communication challenges • Language barrier • Cultural differences • Noise • Communication equipment failure • Attitude • Lack clarity • Information overload • Expectations prejudices • Email overload ● Marine communication channels • Written communication • Verbal communication	

Learning Outcome	Content	Suggested Assessment Methods
	• Nonverbal communication	
2. Use English in written and oral communication	• Terms and concept used in communication • Communication Process • Classification of communication • Forms of Communication • Channels of Communication • Writing Skills • Summary • Report Writing Skills • Conducting Meetings and Minute Writing • Interviews	• Observation • Portfolio of Evidence • Project • Written assessment • Practical assessment • Oral assessment

3. Use internal communication systems onboard	• Types of internal communication systems onboard
	  • GMDSS
	  • Intercom
	  • Public address
	  • Telephones
		• Observation
		• Portfolio of Evidence
		• Project
		• Written assessment
		• Practical assessment
		• Oral assessment

Learning Outcome	Content	Suggested Assessment Methods

4. Execute commands in emergency situations	• Types of emergencies onboard
	  • Sinking
	  • Man overboard
	  • Fire
	  • Grounding
	  • Foundering
	  • Flooding
	  • Piracy
	  • enclosed space rescue
	  • Evacuation
	  • Collision
	  • Power black out
	• emergency signals
	  • Continuous ringing of ships bell
	  • One long blast
	  • General alarm- seven short and one long blast
	  • Flare guns
	  • Fire in a drum
	  • Signaling flags
	  • Pyrotechnics
	  • May day call
	  • Three long blasts
		• Observation
		• Portfolio of Evidence
		• Project
		• Written assessment
		• Practical assessment
		• Oral assessment

5. Recognize the existence of cultural and religious diversities in the maritime sector	• Elements of interpersonal relationship onboard
	  • Good company policies
	  • Good shipboard management
	  • Good technical competencies and
		• Observation
		• Portfolio of Evidence
		• Project
		• Written assessment

Learning Outcome	Content	Suggested Assessment Methods

	Interpersonal relationship of all crew and officers
	• Effective communication skills
	  • Listening skills
	  • People skills
	  • Emotional intelligence
	  • Appropriate skill selection
	  • Ethical communication
	• communication challenges
	  • Language barrier
	  • Cultural differences
	  • Noise
	  • Communication equipment failure
	  • Attitude
	  • Lack clarity
	  • Information overload
	  • Expectations prejudices
	  • Email overload
	  •
		• Practical assessment
		• Oral assessment

6. Prepare shipboard reports	• meaning of report
	• Types of reports
	  • Oral reports
	  • Written
	  • Management
	  • Operations procedures
	  • Production stages
	  • Maintenance, break down
		• Observation
		• Portfolio of Evidence
		• Project
		• Written assessment
		• Practical assessment

Learning Outcome	Content	Suggested Assessment Methods
	and accident reports • Internal memos • Role of report in a company • Preparation for report writing • Audience analysis • Reading skills • Data collection • Data analysis	• Oral assessment

Suggested Methods Instruction

- Blended/Hybrid learning
- Case study
- Coaching
- Community of practice (CoP) learning strategy
- Cooperative learning (Think, pair, share, and Jigsaw)
- Demonstration by trainer
- Flipped classroom
- Group Discussions
- Industrials visits/ Industrial training practical's
- Inquiry-based Learning
- Instructor-led
- Journaling
- Practical Exercise by the trainee(s)
- Reflective discussion
- Roleplaying
- Self-study

Recommended Resources for 24 Trainees

General Resources	Tools and Equipment	Materials and Supplies
• 2 LCD Projector	Computers with internet connection	• Copies of International code of signals
• 5 Whiteboards	• 2 GMDSS Simulator station	• 5 packets of assorted colors of whiteboard marker pens
• Pyrotechnics	• 6 Portable VHF Radio communications	• Assorted Stationery
• Radar reflector	• 1Shipboard Intercom	• Assorted Flags and shapes
• 2 PA system		• Company ISM manual
• Talkback		

DIGITAL LITERACY AND CYBER SECURITY

ISCED UNIT CODE: 0611 541 02B
TVET CDACC UNIT CODE: MET/CU/ETE/BC /02/6/A

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Apply Digital Literacy and maritime cyber security

Duration of Unit: 30 Hours

Unit Description

This unit covers the competencies required to demonstrate digital literacy and maritime cyber security. It involves operating computer devices, solving tasks using the Office suite, managing data and information, performing online communication and collaboration, applying cybersecurity skills, and performing jobs online.

Summary of Learning Outcomes

1. Operate Computer Devices
2. Solve Tasks Using Office Suite
3. Manage Data and Information
4. Perform Online Communication and Collaboration
5. Apply Cybersecurity Skills
6. Perform Online Jobs
7. Apply job entry techniques.
8. Identify applications of artificial intelligence in the maritime industry

Learning Outcomes, Content, and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Operate computer devices	• Meaning and importance of digital literacy • Functions and Uses of Computers • Classification of computers • Components of a computer system • Computer Hardware ◦ The System Unit E.g. Motherboard, CPU, casing	• Observation • Written assessment • Oral assessment • Practical assessment

Learning Outcome	Content	Suggested Assessment Methods
	• Input Devices e.g. Pointing, keying, scanning, voice/speech recognition, direct data capture devices. • Output Devices e.g. hardcopy output and softcopy output • Storage Devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, Hard Drives, CDs & DVDs, Memory cards, Flash drives • Computer Ports e.g. HDMI, DVI, VGA, USB type C etc. ● Classification of computer software ● Operating system functions ● Procedure for turning/off a computer ● Mouse use techniques ● Keyboard Parts and Use Techniques ● Desktop Customization ● File and Files Management using an operating system ● Computer Internet Connection Options • Mobile Networks/Data Plans • Wireless Hotspots • Cabled (Ethernet/Fiber) • Dial-Up • Satellite ● Computer external devices management	

Learning Outcome	Content	Suggested Assessment Methods
	• Device connections • Device controls (volume controls and display properties)	
2. Solve tasks using Office suite	● Meaning and Importance of Word Processing ● Examples of Word Processors ● Working with word documents • Open and close word processor • Create a new document • Save a document • Switch between open documents ● Enhancing productivity • Set basic options/preferences • Help resources • Use magnification/zoom tools • Display, hide built-in tool bar • Using navigation tools ● Typing Text ● Document editing (copy, cut, paste commands, spelling and Grammar check) ● Document formatting • Formatting text • Formatting paragraph • Formatting styles	● Observation ● Portfolio of Evidence ● Project ● Written assessment ● Practical assessment ● Oral assessment

Learning Outcome	Content	Suggested Assessment Methods
	• Alignment • Creating tables • Formatting tables ● Graphical objects • Insert object (picture, drawn object) • Select an object • Edit an object • Format an object ● Document Print setup • Page layout, • Margins set up • Orientation. ● Word Document Printing ● Meaning & Importance of electronic spreadsheets ● Components of Spreadsheets ● Application areas of spreadsheets ● Using spreadsheet application • Parts of Excel screen: ribbon, formula bar, active cell, name box, column letter,row number, Quick Access Toolbar. • Cell Data Types • Block operations • Arithmetic operators (formula bar (-, +, *, /). • Cell Referencing ● Data Manipulation • Using Functions (Sum, Average, SumIF, Count, Max,	

Learning Outcome	Content	Suggested Assessment Methods
	Max, IF, Rank, Product, mode etc) • Using Formulae • Sorting data • Filtering data • Visual representation using charts ● Worksheet printing ● Electronic Presentations ● Meaning and Importance of electronic presentations ● Examples of Presentation Software ● Using the electronic presentation application • Parts of the PowerPoint screen (slide navigation pane, slide pane, notes, the ribbon, quick access toolbar, and scroll bars). • Open and close presentations • Creating Slides (Insert new slides, duplicate, or reuse slides.) • Text Management (insert, delete, copy, cut and paste, drag and drop, format, and use spell check). • Use magnification/zoom tools • Apply or change a theme. • Save a presentations • Switch between open presentations ● Developing a presentation	

Learning Outcome	Content	Suggested Assessment Methods
	• Presentation views • Slides • Master slide • Text • Editing text • Formatting • Tables • Charts • Using charts • Organization charts • Graphical objects • Insert, manipulate • Drawings • Prepare outputs • Applying slide effects and transitions • Check and deliver • Spell check a presentation • Slide orientation • Slide shows, navigation • Print presentations (slides and handouts)	
3. Manage Data and Information	• Meaning of Data and information • Importance and Uses of data and information • Types of internet services • Communication Services • Information Retrieval Services • File Transfer • World Wide Web Services • Web Services	• Observation • Portfolio of Evidence • Project • Written assessment • Practical assessment • Oral assessment

Learning Outcome	Content	Suggested Assessment Methods
	• Automatic Network Address Configuration • NewsGroup • Ecommerce • Types of Internet Access Applications • Web browsing concepts • Key concepts • Security and safety • Web browsing • Using the web browser • Tools and settings • Clearing Cache and cookies • URIs • Bookmarks • Web outputs • Web based information • Search • Critical evaluation of information • Copyright, data protection • Downloads Management • Performing Digital Data Backup (Online and Offline) • Emerging issues in internet	
4. Perform online communication and collaboration	• Netiquette principles • Communication concepts • Online communities • Communication tools • Email concepts • Using email	• Observation • Portfolio of Evidence • Project • Written assessment • Practical assessment

Learning Outcome	Content	Suggested Assessment Methods
	• Sending email • Receiving email • Tools and settings • Organizing email • Digital content copyright and licenses • Online collaboration tools • Online Storage (Google Drive) • Online productivity applications (Google Docs & Forms) • Online meetings (Google Meet/Zoom) • Online learning environments • Online calendars (Google Calendars) • Social networks (Facebook/Twitter - Settings & Privacy) • Preparation for online collaboration • Common setup features • Setup • Mobile collaboration • Key concepts • Using mobile devices • Applications • Synchronization	• Oral assessment
5. Apply cybersecurity skills	• Data protection and privacy • Confidentiality of data/information • Integrity of data/information	• Observation • Portfolio of Evidence • Project

Learning Outcome	Content	Suggested Assessment Methods

	• Availability of data/information
	• Internet security threats
	  • Malware attacks
	  • Social engineering attacks
	  • Distributed denial of service (DDoS)
	  • Man-in-the-middle attack (MitM)
	  • Password attacks
	  • IoT Attacks
	  • Phishing Attacks
	  • Ransomware
	• Computer threats and crimes
	• Cybersecurity control measures
	  • Physical Controls
	  • Technical/Logical Controls (Passwords,PINs, Biometrics)
	  • Operational Controls
	• Laws governing protection of ICT in Kenya
	  • The Computer Misuse and Cybercrimes Act No. 5 of 2018
	  • The Data Protection Act No. 24 Of 2019
		• Written assessment
		• Practical assessment
		• Oral assessment

6. Perform Online Jobs	• Introduction to online working
	• Types of online Jobs
	• Online job platforms
	  • Remotask
	  • Data annotation tech
	  • Cloud worker
	  • Upwork
		• Observation
		• Portfolio of Evidence
		• Project
		• Written assessment
		• Practical assessment
		• Oral assessment

Learning Outcome	Content	Suggested Assessment Methods
	• Oneforma • Appen • Online account and profile management • Identifying online jobs/job bidding • Online digital identity • Executing online tasks • Management of online payment accounts.	

7. Apply job entry techniques	• Types of job opportunities
	  • Self-employment
	  • Service provision
	  • product development
	  • salaried employment
	• Sources of job opportunities
	• Resume/ curriculum vitae
	  • What is a CV
	  • How long should a CV be
	  • What to include in a AC
	  • Format of CV
	  • How to write a good CV
	  • Don'ts of writing a CV
	• Job application letter
	  • What to include
	  • Addressing a cover letter
	  • Signing off a cover letter
	Portfolio of Evidence
	• Academic credentials
	• Letters of commendations
	• Certification of participations
	• Awards and decorations
	Interview skills
	• Listening skills
		• Observation
		• Oral assessment
		• Portfolio of evidence
		• Third party report
		• Written assessment

Learning Outcome	Content	Suggested Assessment Methods
	• Grooming • Language command • Articulation of issues • Body language • Time management • Honesty • Generally knowledgeable in current affairs and technical area	

8. Identify applications of artificial intelligence in the maritime industry	• Definition of terms
	• Use of AI in Autonomous shipping
	  • Autonomous vessels
	  • Remote control operations
	• Predictive Maintenance
	  • Equipment monitoring
	  • Anomaly Detection
	• Routing optimization
	• Automatic Cargo handling
	• Supply chain optimization
	• Safety and security
	  • Collision Avoidance
	  • Piracy Detection
	• Environmental Protection
	  • Emission Monitoring
	  • Oil Spill Detection
	• Crew Assistance and Training
	  • Virtual Assistants
	  • Simulation training
		• Observation
		• Portfolio of Evidence
		• Project
		• Written assessment
		• Practical assessment
		• Oral assessment

Suggested Methods Instruction

Blended/Hybrid learning

- Case study
- Coaching
- Community of practice (CoP) learning strategy
- Cooperative learning (Think, pair, share, and Jigsaw)
- Demonstration by trainer

- Flipped classroom
- Group Discussions
- Industrials visits/ Industrial training practical's
- Inquiry-based Learning
- Instructor-led
- Journaling
- Practical Exercise by the trainee(s)
- Reflective discussion
- Roleplaying
- Self-study

Recommended Resources for 24 Trainees

General Resources	Tools and Equipment	Materials and Supplies
• 2 Smartboard/Smart TV (Where applicable)	• 10 Computers with internet connection	• Computers
• 5 Whiteboard	• 3 LCD Projector	• 10 packets of assorted colors of whiteboard marker pens
• 5 Sample Charts with presentations of data		• Assorted Stationery
• Windows/Linux/Macintosh Operating System		• 5 samples of CVs
• Microsoft Office Software		• 5 samples of job applications
• Google Workspace Account		
• Antivirus Software		

MARITIME WORKPLACE ESSENTIAL SKILLS

ISCED UNIT CODE: 0031 541 03A
TVET CDACC UNIT CODE: MET/CU/ETE/BC /03/6/A

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Apply Maritime workplace essential skills.

Duration of Unit: 30 hours

Unit Description
This unit covers competencies required by an electro technical officer to effectively apply workplace essential skills. It involves the ability to: apply self-management principles, apply interpersonal communication and relationship skills, apply critical safe work habits, apply financial literacy skills, apply workplace ethics, maintain professional growth and development, apply workplace learning and apply problem solving skills.

Summary of Learning Outcomes

1. Apply self-management principles.
2. Apply interpersonal communication and relationship skills.
3. Apply critical safe work habits.
4. Apply financial literacy skills.
5. Apply workplace ethics.
6. Maintain professional growth and development.
7. Apply workplace learning.
8. Apply problem solving skills

Learning Outcomes, Content, and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply self-management principles	● Self-awareness ● Accountability and Responsibility ● Formulating personal vision, mission, and goals ● Strengths and weaknesses ● Strategies for overcoming work challenges	● Observation ● Written assessment ● Oral assessment ● Third party reports ● Portfolio of evidence

Learning Outcome	Content	Suggested Assessment Methods
	● Emotional intelligence Coping with Work Stress. ● Assertiveness versus aggressiveness and passiveness ● Developing and maintaining high self-esteem ● Developing and maintaining positive self-image ● Time management, Punctuality ● Motivation ● Setting performance targets ● Monitoring and evaluating performance targets	● Project ● Practical
2. Apply interpersonal communication and relationship skills	● Developing Healthy workplace relationships ● Individual responsibilities in a team ● Determination of team roles and objectives. ● Team parameters and relationships. ● Benefits of teamwork. ● Qualities of a team player. ● Leading a team ● Basic Team working principles ● Conflicts and methods of conflict resolution ● Writing, reading and speaking skills ● Internal and external customer needs ● Empathy ● Persuasion ● Adaptability and flexibility	● Observation ● Written assessment ● Oral assessment ● Third party reports ● Portfolio of evidence ● Project ● Practical
3. Apply critical safe work habits	● Stress management	● Observation

Learning Outcome	Content	Suggested Assessment Methods
	● Punctuality and Time consciousness. ● Relationship between Personal Objectives and Organizational goals. ● Setting of work priorities. ● Leisure time ● Abstinence from drug and substance abuse. ● HIV and AIDS ● Safety consciousness ● Emerging issues in the work place	● Written assessment ● Oral assessment ● Third party reports ● Portfolio of evidence ● Project ● Practical

4. Apply financial literacy skills	● Sources of Personal funds;
	  • Salary
	  • Investments
	  • Savings
	  • Inheritance
	  • Government benefits
	● Sources of business finance
	  • Equity Financing
	  • Debt Financing
	  • Personal Savings
	  • Retained earnings
	  • Grants and subsidies
	  • Crowd funding
	  • Supplier credit
	  • Leasing and asset financing
	● Methods of investment
	● Management of savings
	● Management of debts
	● Procurement of insurance services
		● Observation
		● Written assessment
		● Oral assessment
		● Third party reports
		● Portfolio of evidence
		● Project
		● Practical

5. Apply workplace ethics	● Organizational codes of conduct ● Industry policies and procedures	● Observation

Learning Outcome	Content	Suggested Assessment Methods
	• Professionalism • Integrity	• Written assessment • Oral assessment • Third party reports • Portfolio of evidence • Project • Practical
6. Maintain professional growth and development	• Personal growth and development needs • Training and career opportunities • Training Resources mobilization • Licenses and certifications • Career advancement • Managing work priorities and personal commitments • Dynamism and on-the-job learning	• Observation • Written assessment • Oral assessment • Third party reports • Portfolio of evidence • Project • Practical
7. Apply workplace learning	• Training and career opportunities • Assessing training needs • Mobilizing training resources • Licenses and certifications for professional growth and development • Types of media for learning • Pursuing personal and organizational goals	• Observation • Written assessment • Oral assessment • Third party reports • Portfolio of evidence • Project • Practical
8. Apply Problem-solving skills	• Causes of problems • Methods of solving problems • Problem-solving process • Decision making • Creative thinking and critical thinking process in development	• Observation • Written assessment • Oral assessment • Third party reports

Learning Outcome	Content	Suggested Assessment Methods
	of innovative and practical solutions	• Portfolio of evidence • Project • Practical

Suggested Methods of Instruction

- Blended/Hybrid learning
- Case study
- Coaching
- Community of practice (CoP) learning strategy
- Cooperative learning (Think, pair, share, and Jigsaw)
- Demonstration by trainer
- Flipped classroom
- Group Discussions
- Industrials visits/ Industrial training practical's
- Inquiry-based Learning
- Instructor-led
- Journaling
- Practical Exercise by the trainee(s)
- Reflective discussion
- Roleplaying
- Self-study

Recommended Resources for 24 Trainees

General Resources	Tools and Equipment	Materials and Supplies
• 3 LCD Projectors	• 10 Computers with internet connection	• Computers
• 5 Whiteboards		• 10 packets of assorted colors of whiteboard marker pens
• Sample Charts with presentations of data		• Stationery
• Video clips		
• Audio tapes		
• Radio sets		

COMMON UNITS OF LEARNING

MARITIME ENGINEERING MATHEMATICS

UNIT CODE: 0541 541 04A
TVET CDACC UNIT CODE: MET/CU/ETE/CC /01/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Apply Maritime Engineering mathematics
Duration of Unit: 100 hours
Unit Description
This unit describes the competencies required by an Electrotechnical officer to apply a wide range of engineering mathematics in their work. This includes applying rules of algebra, applying rules of logarithms, applying rules of trigonometry and hyperbolic functions, Applying complex numbers, performing coordinates geometry and graphing, applying vector theory, applying calculus differentiation, applying calculus integration and applying Binary hexadecimal number system and logic.

Summary of Learning Outcomes

1. Apply rules of algebra
2. Apply rules of logarithms
3. Apply rules of trigonometry and hyperbolic functions
4. Apply complex numbers
5. Perform coordinates geometry and graphing
6. Apply vector theory
7. Apply calculus differentiation
8. Apply calculus integration
9. Apply Binary hexadecimal number systems and logic

Learning Outcomes, Content and Suggested Assessment Methods

Electrical Curriculum		
Learning Outcome	**Content**	**Suggested Assessment Methods**
1. Apply rules of Algebra	• Base and Index • Law of indices • Indicial equations • 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
2. Apply rules of logarithms	• Introduction to Logarithms • Laws of logarithm • Solving Logarithmic equations • Conversion of bases • Logarithmic Calculations • Use of calculator • Use of logarithmic tables to solve logarithmic problems	• Written tests • Oral questioning • Assignments • Supervised exercises
3. Apply rules of trigonometry and hyperbolic functions	• Trigonometric ratios of acute angles • Evaluating of trigonometric ratios • Solution of right-angled triangles • Sine and cosine rules • Trigonometric Identities • Trigonometric equations • Solving problems on trigonometric equations	• Assignments • Oral questioning • Supervised exercises • Written tests

	• Meaning of hyperbolic equations • Hyperbolic identities • Evaluations of hyperbolic functions • Series expansions of coshx and sinhx • Relationship between trigonometric and hyperbolic functions • Inverse functions for one-to-one relationship • Inverse functions for trigonometric functions • Graph of inverse functions • Inverse hyperbolic functions	
4. Apply complex numbers	• Meaning of complex numbers • Stating complex 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	• Written tests • Oral questioning • Assignments • Supervised exercises
5. Perform coordinates geometry and graphing	• Polar equations • Cartesian equation • Changing from cartesian to polar coordinates.	• Written tests • Oral questioning • Assignments • Supervised exercises

	• Changing from polar coordinates to cartesian co-ordinates • 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.	
6. Apply vector theory	• Vector and Scalar quantities • Operation of 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	• Written tests • Oral questioning • Assignments • Supervised exercises
7. Apply calculus differentiation	• Derivatives of functions • Derivatives of trigonometric and hyperbolic functions • Derivatives of inverse trigonometric functions • Formation of first order differential equation • Solution of first order differential equations	• Written tests • Oral questioning • Assignments • Supervised exercises

	• Formation of second order differential equations for various systems • Solution of second order differential equations • Application of second order differential equations • Solution of partial differential equations by direct partial integration • Partial Differentiation • Rates of change and small change • Maxima, Minima and Saddle points	
8. Apply calculus integration	• The process of integration • The general solution of integrals of the form ax^n • Standard integrals • Integration using algebraic substitutions • Integration using algebraic substitutions • Integration using trigonometric and hyperbolic substitutions • Integration using partial fractions • Integration by parts	• Written tests • Oral questioning • Assignments • Supervised exercises
9. Apply Binary hexadecimal number systems and logic	• Binary number system • Decimal to binary number system • Octal Number system • Binary coded decimal • Hexadecimal number system • Three Basic Logic Gates	• Written tests • Oral questioning • Assignments • Supervised exercises

Suggested Methods of Instruction

- Group discussions
- Demonstration by trainer
- Exercises by trainee

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
• 5 LCD Projector	• 10 Computers with internet connection	• 2 Screen projector
• 5 Whiteboard	• 5 Dice	• 10 packets of assorted colors of whiteboard marker pens
		• 24 Graph books
		• 24 Scientific Calculator
		• 24 Rulers, pencils, erasers

ENGINEERING DRAWING

UNIT CODE: 0732 541 05A
TVET CDACC UNIT CODE: MET/CU/ETE/CC /02/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Prepare and interpret engineering drawing

Duration of Unit: 30 hours

Unit Description
This unit covers the competencies required to by an electro technical officer to prepare and interpret engineering drawing. It includes preparing drawing equipment and materials, producing plain geometry drawings, producing pictorial and orthographic drawings of components, producing solid geometry drawing, preparing assembly drawing, interpreting machinery drawings and handbooks, interpreting electrical and electronic systems technical drawings and interpreting piping, hydraulic and pneumatic drawings.

Summary of Learning Outcomes

1. Prepare drawing equipment and materials
2. Produce plane geometry drawings
3. Produce pictorials and orthographic drawing of components
4. Produce solid geometry drawings
5. Produce assembly drawings.
6. Interpret machinery ship drawings and handbooks
7. Interpret electrical and electronic systems technical drawings
8. Interpret piping hydraulic and pneumatic drawings

Learning Outcomes, Content and Suggested Assessment Methods:

Learning Outcome	Content	Suggested Assessment Methods
1. Prepare drawing equipment and materials	• Identification and care of drawing equipment • Identification and care of drawing materials • Reference to manufacturer's instructions and work place	• Observation • Oral questioning • Written tests

Learning Outcome	Content	Suggested Assessment Methods
	procedures on use and maintenance of drawing equipment and materials • Reference to relevant environmental legislations • Use of Personal Protective Equipment (PPEs)	
2. 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 • Written Assignments • Observation
3. Produce Pictorial and orthographic drawings of components	• Meaning of pictorial and orthographic drawings • Free hand sketching • Meaning of sectioning • Meaning of symbols and abbreviations • Drawing objects in isometric view • Drawing objects in oblique view • Drawing and interpretation of First and third angle orthographic elevations • Dimensioning of orthographic elevations • Pictorial and Orthographic drawings using AutoCAD.	• Observation • Written Assignments • Oral questioning
4. Produce solid geometry drawings	• Interpretation of sketches and drawings of patterns e.g. cylinders, prisms and pyramids • Patterns of solid geometry • Sectioning of solids e.g. prisms, cones	• Observation • Written Assignments • Oral questioning

Learning Outcome	Content	Suggested Assessment Methods
	• Development and interpenetrations of solids e.g. cylinder to cylinder and cylinder to triangular, prism • Solid geometry drawings using AutoCAD	
5. Prepare Assembly Drawing	• Types of Assembly Drawings • Assembly drawing • Orthographic views of assembly drawing • Sectioning of views • How to Generate Parts list • Assembling drawing using AutoCAD	• Observation • Oral questioning • Written Assignments •
6. Interpret machinery, ship drawings and handbooks.	• Drawing symbols and Dimensions • Ship dimensions • locating shell plating and frames from ship drawing • Drawing machinery and equipment • Identification of valves and pipe sizes from drawings • Indicate Types of fluid and direction of flow on the drawing • Indicate Sequence of operation of valves/machinery • Assembly and di-assembly of machinery • Identification of machinery components from a drawing • Interpretation of drawings e.g dimensions, instructions and material requirements	• Observation • Oral questioning • Written Assignments
7. Interpret electrical and electronic systems technical drawings	• Electrical symbols and abbreviations • Meaning of electrical drawings	• Observation • Oral questioning • Assignments

Learning Outcome	Content	Suggested Assessment Methods
	• Drawing of electrical diagrams e.g. block, schematic, circuit, line and wiring	
8. Interpret piping, hydraulic and pneumatic drawings	• Drawing hydraulic and pneumatic symbols • Identification of hydraulic and pneumatic machinery from a drawing • Identification of valves and pipe sizes from drawings • Indicate Types of fluid and direction of flow on the drawing • Indicate Sequence of operation of valves/machinery	• Observation • Oral questioning • Written Assignments

Suggested Methods of Instruction

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

Recommended Resources for 24 Trainees

General Resources	Tools and Equipment	Materials and Supplies
• 10 Desktop computers/laptops	• 5 Compasses	• 10 packets of Flashcards
• Internet connection	• 5 packets of Drawing papers	• 5 rolls of Flip charts
• 3 Projectors • 2 Printers	• 24 Rulers • 24 Erasers	• 10 packets of assorted colors of whiteboard marker pens
• 5 Drawing boards	• 24 sets of assorted drawing Pencils	• Printing papers (2 rims)
• 24 Report writing templates	• 24 Technical pens	•
• 1 Engine room simulator	• 24 Mechanical pens	•

ELECTRICAL AND ELECTROTECHNOLOGY PRINCIPLES

UNIT CODE: 0714 541 06A
TVET CDACC UNIT CODE: MET/CU/ETE/CC /03/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Apply electrical and electrotechnology principles
Duration of Unit: 240 hours

Unit Description
This unit describes the competencies required by an electro technical officer to apply electrical and electrotechnology principles by applying knowledge of electricity generation, Knowledge of electrical materials, knowledge of electro-hydraulic and electro pneumatic systems, knowledge of basic electronics and power electronics principles, knowledge of instrumentation, alarm and monitoring systems, knowledge of electrical machines, fundamentals of asynchronous and synchronous machines, knowledge of electrical power distribution boards and electrical equipment, knowledge of automation, automatic control systems and technology and knowledge of hazards and precautions for operating high voltage installations

Summary of Learning Outcomes
1. Apply knowledge of electricity generation
2. Apply knowledge of electrical materials
3. Apply knowledge of electro-hydraulic and electro-pneumatic systems
4. Apply Knowledge of basic electronics and power electronics principles
5. Apply knowledge of instrumentation, alarm, and monitoring systems
6. Apply knowledge of electrical drives
7. Apply fundamentals of electrical circuits
8. Apply fundamental of magnetism and electromagnetic induction
9. Apply fundamentals of electrical machines
10. Apply fundamentals of asynchronous and synchronous machines
11. Apply knowledge of electrical power distribution boards and electrical equipment
12. Apply knowledge of automation, automatic control systems and technology
13. Apply knowledge of hazards and precautions for operating high voltage installations

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Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Apply knowledge of electricity generation	• Basic SI units
	• SI unit of various types of Electrical parameters
	• Ohm's law
	• Calculations involving various Electrical parameters e.g. Power, Current, Voltage, Resistance
	• Quantities of charge
	• Force, work and power
	• Electromagnetic field theory
	• Applications of electromagnetic field theory
	• Electromagnetic laws
	  • Faraday's law
	  • Lenz's law
	  • Fleming's law
	• Properties and Effects of Electromagnetic Waves
	• Waves characteristics and shielding
		• Observation
		• Oral questioning
		• Written tests

2. Apply knowledge of electrical materials	• Meaning of terms • Types of materials • Insulators • Conductors • Semiconductors • Semiconductor materials • Types of semiconductors materials • Intrinsic and Extrinsic	• Observation • Oral questioning • Written tests
3. Apply knowledge of electro-hydraulic and electro-pneumatic systems	• Principles of hydraulic and pneumatic drives • Construction of hydraulic systems • Operation of hydraulic systems • Construction of pneumatic systems • Operation of pneumatic systems	• Written tests • Oral questioning

Learning Outcome	Content	Suggested Assessment Methods
	• Applications of marine hydraulic machinery • Applications of marine pneumatic machinery	

4. Apply Knowledge of basic electronics and power electronics principles	• Meaning of terms
	• P-N juction
	• Semiconductor diodes
	• Foreward and reverse Characteristics
	• Types of semicondctor diodes
	• Application of semiconductors diodes
	• Types of special semiconductor devices
	  • UJT
	  • SCR
	  • LASCR
	  • TRIAC
	  • DIAC
	  • SCS
	• Application of special semiconductor devices
	• Bipolar junction transistors
	• Operation of NPN and PNP
	• Field effect transistors
	• Operation N and P channels
	• Types of FETs
	• BJTs and FETs biasing
	• BJTs and FETs configuration
	• Characteristics of transistors
	• Gain of transistors
	• DC/AC load lines
		• Observation
		• Oral questioning
		• Written tests

5. Apply knowledge of instrumentation, alarm, and monitoring systems	• Monitoring systems • Integrated Alarm, Monitoring and Control System (IAMCS) • Properties of sensors used onboard • Types of sensors	• Observation • Oral questioning • Written tests

Learning Outcome	Content	Suggested Assessment Methods

	• Methods of communication with smart transducers
	• Highway addressable remote transducer protocol (HART)
	• Principle of communication with programmable transducers
	  • Foundation Fieldbus
	  • Profibus PA protocol.
	• Construction of long-distance digital measuring lines
	• Alarm detection systems
	  • Principles of operation of fire detection alarm system
	  • Principles of operation of the photoelectric oil detection system
	  • Principle operation of the oxygen and other gases detection system	

6. Apply knowledge of electrical drives	• Meaning of terms • Types of drive • Factors that affect the choice of a motor for a particular drive • Applications of various drives • Heating and cooling curves • Motor power rating • Dismantling and assembling electric drives • Motor enclosures	• Written tests • Oral questioning

7. Apply fundamentals of electrical circuits	• Meaning of terms
	• Ohm's law
	• Kirchoff's law
	• Electrical and electronic measurement
	• Series and parallel calculations
	  • RL
	  • RC
	  • RLC
		• Written tests
		• Oral questioning
		• Practical tests
		• Observation

Learning Outcome	Content	Suggested Assessment Methods

	• Series and parallel calculations using complex numbers
	  • RL
	  • RC
	  • RLC
	• Three phase systems
	  • Principle of three phase systems
	  • Three phase power measurement
	  • Line and phase quantities
	  • Calculations on three phase
	  • Methods of three phase power measurement
	• Transients
	  • Meaning of growth and decay in R-L &R-C circuits
	  • Calculations involving R-L & R-C circuits
	  • Applications of growth and decay in R-L & R-C circuits.	

8. Apply fundamental of magnetism and electromagnetic induction	• Magnetic field • Direction of magnetic field, motion and current • Coil inductance with iron core • Coil inductance without iron core • Principles of electromagnetic induction • Laws of electromagnetic induction • Applications of electromagnetic induction	•

9. Apply fundamentals of electrical machines	• 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
		•

Learning Outcome	Content	Suggested Assessment Methods
	• Resistance starter • Shaded pole • Split phase • Capacitor start • Capacitor Start capacitor run • Face plate Starting • Application of AC and DC machines • Special machines and their applications	
10. Apply fundamentals of asynchronous and synchronous machines	• Construction features of asynchronous machines. • Operating principles of asynchronous machines. • Equivalent circuit and phasor diagram of asynchronous motor. • Components of asynchronous • Properties of cylindrical and salient pole machines • Construction features of asynchronous machines. • Operating principles of synchronous machines. • Equivalent circuit and phasor diagram of synchronous motor. • Components of synchronous • Calculations involving synchronous machines • Graphs of speed, load and current on no load and full load. • Effects of supply voltage and frequency variation on the operation of synchronous machines • Applications of synchronous machine	•
11. Apply knowledge of electrical power	• Basic parameters of electrical power distribution system • Nominal voltage	•

Learning Outcome	Content	Suggested Assessment Methods
distribution boards and electrical equipment	• On-load voltage • Test voltage • Protection grade • Nominal current • Peak power • Power factor • Processes of electrical heating, continuous load, intermittent load and part-time or short circuit load • Short circuit tolerance • Temperature dependence • Marine environment exposures • Insulated neutral system • Structural parts of shipboard power transmission • Structure of shipboard electrical • switchboards • Feeder lines • Branch circuits • Distribution boards • Switchgear boards • Tie-breaker boards • Electrical protective devices • Fuses • Automatic circuit breakers • Disconnect switches • Lightning arrestors • Protective relays (overcurrent, thermal overload, undervoltage etc) • Contactors • Insulation monitoring devices • Electrical power distribution devices • Classification of marine cables • Rules of arrangement and shielding of marine cables	

Learning Outcome	Content	Suggested Assessment Methods
	• Stroboscopic phenomenon and effects	
12. Apply knowledge of automation, automatic control systems and technology	• Concept of Automatic control system • Concept of programmable logic control system • PID control system • Offset and effects • Concept of programmable automatic control • Hand/ auto change over station • Schematic diagrams of automatic control loop • Components of automatic control systems • Operation of automatic control systems • Fail safe • Concept of programmable logic control system • Constructional features of air to open and air to close actuators.	•
13. Apply knowledge of hazards and precautions for operating high voltage installations	• Electric Shock • Effects of electric shock • Electric shock by electrostatic charges • Shock voltage and shock current • Low voltage and High voltage electric shock • Parameters of electric arc • explains and describes general HV protection measures: housings, partitions, distances, insulation mats, insulation materials, access restrictions, markings and warnings, HV equipment access monitoring and locks • explains and describes how to use fixed and portable HV measurement	•

Suggested Methods of Instruction

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

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies

Laboratories:
 	
• **Electrical Circuits Laboratory:** Equipped with power supplies, oscilloscopes, function generators, and various measurement instruments for hands-on experiments in circuit analysis and design. (1)
• **Electronics Laboratory:** Includes soldering stations, breadboards, multimeters, and specialized equipment for testing and prototyping electronic circuits. (1)
• **Control Systems Laboratory:** Focuses on practical applications of control theory, featuring programmable logic controllers (PLCs), sensors, actuators, and industrial automation equipment (1)
 	
Computers and Workstations (24):
	• **Power Supplies**
	  • Variable DC Power Supplies
	  • AC Power Supplies
	
	• **Measurement Instruments (24):**
	  • Digital Multimeters
	  • Oscilloscopes
	  • Function Generators
	  • Power Meters
	
	• **Components and Devices (24):**
	  • Resistors (various values and types)
	  • Capacitors
	  • Inductors
	  • Transformers
	  • Diodes
	  • Transistors (BJT, MOSFET)
	  • Integrated Circuits (ICs)
	  • Relays
	
	• **Tools for Assembly and Testing (24):**
	  • Soldering Irons and Soldering Stations
	  • Breadboards
	  • Wire Cutters and Strippers
	  • Crimping Tools
		• **Safety Signage and Instructions** (1 each):
		  • Clear signage indicating safety protocols and emergency procedures.
		  • Instructional posters on proper lathe operation and safety tips.
		
		• 24 packets Flashcards
		• 10 rolls of Flip charts
		• 10 packets of assorted colors of whiteboard marker pens
		• 2 rims Printing papers
		• 24 copies Technical Publications: Industry standards, manuals, and guidelines from organizations like the International Maritime Organization (IMO) and classification societies (2 each)
		• Textbooks and References (24 each)
		
		Instructional Materials (24 each)**:**
		
		  • Manuals and guides specific to the lathe machine model.

○ Equipped with necessary software and internet access • Training Workshops and Laboratories (1) • Internet connection • 1 Projector • 1 Printer • 1 Whiteboard • Report writing templates • Interactive Whiteboards (1) • Ship Engine Room Simulator (1) **Training Facility:** • **Workshop Space** (1): • **Power Supply:** ○ Reliable electrical supply with proper voltage and amperage for machines	• PCB (Printed Circuit Board) Prototyping Equipment • **Simulation Software (24):** • Circuit Simulation Software (e.g., SPICE) • PCB Design Software (e.g., Altium Designer, Eagle) • MATLAB/Simulink for control system analysis and design • **Safety Equipment (24 sets):** • Safety Goggles • Antistatic Mats and Wrist Straps • Fire Extinguishers	• Online resources, including videos and tutorials, for supplementary learning **Educational Materials:** • **Digital Resources (5):** • Online tutorials and video demonstrations • **Training Modules (24 copies):** • Safety protocols and best practices

SHIP CONSTRUCTION PRINCIPLES

UNIT CODE: 0716 541 07A
TVET CDACC UNIT CODE: MET/CU/ETE/CC /04/6/A

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Apply ship construction principles
Duration of Unit: 40 hours

Unit Description
This unit describes the competencies required by a marine engineering officer to apply ship construction principles. It entails identifying ship dimension and forms, structural components of a ship, structural components of bow and stern, ship fittings, types of rudders and propeller, load lines and draught marks and ship stresses.

Summary of Learning Outcomes (copy from Elements in OS)

1. Identify ship dimension and forms.
2. Identify structural components of a ship.
3. Identify structural components of bow and stern.
4. Identify ship fittings.
5. Identify types of rudders and propeller
6. Identify load lines and draught marks.
7. Identify ship stresses
8. Check weather tight and watertight integrity of ship

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome These are elements as outlined in occupational standards for each unit of competency	**Content** Should have Required knowledge, skills and worker behaviour to perform task	**Suggested Assessment Methods** How assessment should be conducted for the specific learning outcome/task/elements
1. Identify ship dimension and forms.	• Introduction to ship construction • Ship forms • Ship dimensions	• Written tests • Reflection papers • Individual/group Projects

	• Ship construction materials • Steels used in ship construction	• Visual or audio recording of Presentations • Individual/group assignments • Journal entries • Online assessment methods
2. Identify structural components of a ship.	• Bulkheads construction • Midship sections construction • Bulkheads openings structural integrity • Structural design and constructions for fire safety • Bulkhead • Fire doors • Framing systems	• Written tests • Reflection papers • Individual/group Projects • Visual or audio recording of Presentations • Individual/group assignments • Journal entries • Online assessment methods
3. Identify structural components of bow and stern.	• Bow construction • Stern construction • Anchor and chain • Rudder support arrangements	• Written tests • Reflection papers • Individual/group Projects • Visual or audio recording of Presentations • Individual/group assignments • Journal entries • Online assessment methods
4. Identify ship fittings.	• Ship fittings construction and arrangement • Deck machinery fittings • Watertight integrity and weather tight integrity • Stress raisers • Overboard valves • Bilge keels	• Written tests • Reflection papers • Individual/group Projects • Visual or audio recording of Presentations • Individual/group assignments • Journal entries

		• Online assessment methods
5. Identify types of rudders and propeller	• Types of rudders • Rudder construction • Types of propellers • Propeller construction • Screw propulsion principles	• Written tests • Reflection papers • Individual/group Projects • Visual or audio recording of Presentations • Individual/group assignments • Journal entries • Online assessment methods
6. Identify load lines and draught marks.	• Loadlines and draft marks • Importance of freeboard • Condition of assignment of freeboard	• Written tests • Reflection papers • Individual/group Projects • Visual or audio recording of Presentations • Individual/group assignments • Journal entries • Online assessment methods
7. Identify ship stresses	• Types of ships stresses • Hull components • Hull painting • Anti-corrosion arrangements	• Written tests • Reflection papers • Individual/group Projects • Visual or audio recording of Presentations • Individual/group assignments • Journal entries • Online assessment methods
8. Check weather tight and watertight integrity of ship	• Ship inspection • Safety inspection • Weather tight and watertight integrity checks	• Written tests • Reflection papers • Individual/group Projects • Visual or audio recording of Presentations

		• Individual/group assignments • Journal entries • Online assessment methods

Suggested Methods of Instruction:

Blended/Hybrid learning

● Case study
● Coaching
● Community of practice (CoP) learning strategy
● Cooperative learning (Think, pair, share, and Jigsaw)
● Demonstration by trainer
● Flipped classroom
● Group Discussions
● Industrials visits/ Industrial training practical's
● Inquiry-based Learning
● Instructor-led
● Journaling
● Practical Exercise by the trainee(s)
● Reflective discussion
● Roleplaying
● Self-study

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
• 2 Desktop computers/laptops		10 Flashcards
• Internet connection		5 Flip charts
• 1 Projector • 1 Printer		2 packets of assorted colors of whiteboard marker pens
• 1 Whiteboard		Printing papers (2 rims)
• 25 Report writing templates		

THERMODYNAMIC PRINCIPLES

UNIT CODE: 0715 541 08A
TVET CDACC UNIT CODE: MET/CU/ETE/CC /05/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Apply Thermodynamics principles
Duration of Unit: 30 hours
Unit Description
This unit describes the competencies required by an electro technical officer to apply Thermodynamic Principles in their work. It involves applying knowledge of work transfer, ideal gases, thermodynamic processes, vapours, heat transfer, energy change, applying working principles of air compressors and fluid pumps, internal combustion engines and gas power cycles and Refrigeration and Air conditioning plant

Summary of Learning Outcomes

1. Apply knowledge of work transfer
2. Apply Knowledge of ideal gases
3. Apply knowledge of thermodynamic processes
4. Apply knowledge of vapours
5. Apply knowledge of heat transfer
6. Apply knowledge of energy change
7. Apply working principles of air compressors and fluid pumps
8. Apply knowledge of working principles of internal combustion engines and gas power cycles
9. Apply knowledge of the working principles of Refrigeration and Air conditioning plant

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply knowledge of work transfer	• Definition of terms • Thermodynamic processes and cycles • Calculations on work done • Work done by a fluid exerting constant pressure on a piston	• Written tests • Oral questioning • Assignments • Supervised exercises

	• Work done by a piston during polytropic expansion and compression • Equations of work transfer	
2. Apply Knowledge of ideal gases	• Meaning of terms • Ideal gas equation • Gas laws • calculations	• Written tests • Oral questioning • Assignments • Supervised exercises
3. Apply knowledge of thermodynamic processes	• Definition of terms • The principle of thermodynamics • Laws of thermodynamics • Thermodynamic processes • Thermodynamic cycles • Isothermal process • Adiabatic process • Applications of adiabatic and isothermal processes • PV diagrams for standard processes	• Assignments • Oral questioning • Supervised exercises • Written tests • Practical tests
4. Apply knowledge of vapours	• Meaning of Terms • Steam and refrigerant processes • Relationship between pressure and temperature for saturated liquid. • Calculate enthalpy, internal energy and volume at any given condition of pressure and / or temperature using tables of thermodynamic properties.	• Assignments • Oral questioning • Practical tests • Observation • Written test
5. Apply knowledge of heat transfer	• Define heat transfer processes • Newton's law of cooling • Fourier's law • Specific heat capacity • Calculations on specific heat capacity • Final temperature of substances	• Assignments • Oral questioning • Practical tests • Observation • Supervised exercises • Written tests
6. Apply knowledge of energy change	• Energy changes • Derive non-flow equation from first law of thermodynamic • Energy transfer in a closed system	• Assignments • Supervised exercises • Written tests • Practical test

	• Calculations on energy changes	
7. Apply working principles of air compressors and fluid pumps	• Meaning of terms • Types of air compressors • Types of fluid pumps • Principle of operation of fluid pumps • Principle of operation of air compressors	• Assignments • Oral questioning • Supervised exercises • Written tests
8. Apply knowledge of working principles of internal combustion engines and gas power cycles	• Meaning of terms • Types of engines • Operating principles of two-stroke internal combustion engines • Operating principles of four-stroke internal combustion engines • Operating principles of gas and steam turbine	• Assignments • Oral questioning • Supervised exercises • Written tests
9. Apply knowledge of the working principles of Refrigeration and Air conditioning plant	• Definition of terms • Principle of refrigeration • Temperature/enthalpy and pressure/enthalpy diagrams • Types of refrigerants used in RAC machines • Effects of refrigeration • Plant capacity • calculate refrigeration effect and condition of vapour after expansion using refrigeration tables. • Operating cycle of self-contained and centralised air conditioning systems • Relative humidity • Features of psychrometric chart	• Assignments • Oral questioning • Supervised exercises • Written tests

Suggested Methods of Instruction

- Group discussions
- Demonstration by trainer
- Exercises by trainee

Recommended Resources 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
• 1 steam plant	• Scientific Calculators (1 each)	• Relevant reference materials 24
• 1 Refrigeration unit	• 24 Laboratory instruments	• 1 Screen projector
• 1 LCD Projector		• 10 packets of assorted colors of whiteboard marker pens
1 Whiteboards		

PHYSICAL SCIENCE PRINCIPLES

UNIT CODE: 0715 541 09A
TVET CDACC UNIT CODE: MET/CU/ETE/CC /06/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Apply physical science principles

Duration of Unit: 60 hours

Unit Description
This unit of competency describes the competencies required by an Electro-Technical officer to apply physical science principles by applying knowledge of statics, dynamics, hydrostatics, hydraulics, corrosion prevention, water testing and fuel and lubrication oil properties.

Summary of Learning Outcomes

1. Apply knowledge of statics.
2. Apply knowledge of dynamics.
3. Apply knowledge of hydrostatics.
4. Apply knowledge of hydraulics.
5. Apply knowledge of corrosion prevention.
6. Apply knowledge of water testing and treatment.
7. Apply knowledge of fuel and lubrication oil properties

Learning Outcomes, Content and Suggested Assessment Methods:

Learning Outcome	Content	Suggested Assessment Methods
1. Apply knowledge of statics.	• Definition of terms • Concurrent forces • Principle of moments • Calculation of moments • Resolution of coplanar forces • Calculation of couples	• Oral questioning • Written tests
2. Apply knowledge of dynamics.	• Definition of terms • Principles of dynamics • Laws of friction • Calculate limiting friction	• Oral questioning • Practical tests • Written tests

	• Methods of increasing and reducing friction • Calculate Resultant velocity using parallelogram and triangle of velocities. • Displacement - time graphs • Calculation of Motion	
3. Apply knowledge of hydrostatics.	• Definition of terms • Calculate pressure exerted by liquid. • Determine the forces acting on the surface of a rectangular tank filled with liquid using theoretical values.	• Observation • Oral questioning • Practical tests • Written tests
4. Apply knowledge of hydraulics.	• Definition of terms • Energies stored in a liquid in motion • Calculate the mass flow of a liquid using given theoretical values • Determine the volumetric flow of a liquid using given theoretical values	• Observation • Oral questioning • Practical tests • Written tests
5. Apply knowledge of corrosion prevention.	• Definition of terms • Process of corrosion • Methods of protection of boilers from corrosion • Types of corrosion • Disadvantages of corrosion • Process of material failure • Factors affecting corrosion process • Methods of surface protection • Importance of surface preparation prior to application of protective coating	• Observation • Oral questioning • Practical tests • Written tests
6. Apply knowledge of water testing and treatment.	• Meaning of terms • Merits of controlling PH values of aqueous solution • Merits of maintaining boiler water • Importance of maintaining gas free condition of boiler water and jacket cooling water • methods of testing boiler water and jacket cooling water	• Observation • Oral questioning • Practical tests • Written tests

	• methods of treating boiler water and jacket cooling water • Objectives of treating boiler water	
7. Apply knowledge of fuel and lubrication oil properties	• Definition of terms • Properties of fuel • Flash point temperature of marine fuels and lubricants • Tests of fuel and lubricants	• Observation • Oral questioning • Practical tests • Written tests

Suggested Methods of Instruction

- Demonstration by trainer
- Practice by the trainee
- Field trips
- On-job-training
- Discussions

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
• Laboratory instruments 24 thermometers, hydrometers	• 24 Samples	• Relevant textbooks 1 each
• 1 Whiteboards		• 2 Screen projector
• 1 LCD Projector	• PPE –hand gloves, dust coat, dust masks	• 10 packets of assorted colors of whiteboard marker pens

WORKSHOP PRACTICES

UNIT CODE: 0715 551 10A
TVET CDACC UNIT CODE: MET/CU/ETE/CC /07/6/A
Relationship to Occupational Standards
This unit addresses the unit of competency: Apply workshop practice

Duration of Unit: 100 hours

Unit Description
This unit specifies competencies required by an electro technical officer to apply workshop practice It involves applying Electrical workshop safety practice, performing engineering measurement, carrying out bench and portable grinding operations, applying material safety data sheet information, performing soldering and brazing, operating hand tools and electrical and electronic measuring equipment, maintaining electrical workshop tools and equipment and carrying out Electrical workshop housekeeping practices.

Summary of Learning Outcomes:

1. Apply electrical workshop safety practices
2. Perform engineering measurements
3. Carry out bench work and portable grinding operations
4. Apply material safety data sheet information
5. Perform soldering and brazing
6. Operate hand tools and electrical and electronic measurement equipment
7. Maintain Electrical workshop tools and equipment
8. Carry out Electrical workshop housekeeping practices.

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
These are elements as outlined in occupational standards for each unit of competency	Should have Required knowledge, skills and worker behaviour to perform task	How assessment should be conducted for the specific learning outcome/task/elements

1. Apply electrical workshop safety practices	• Introduction to Occupational Safety and Health (OSH) • Definition and Importance of OSH • Legal and Regulatory Framework (e.g., OSHA, local regulations) • Responsibilities of Employers and Employees • Safety Policies and Procedures • Overview of Workshop Safety Policies • Standard Operating Procedures (SOPs) • Emergency Procedures and Contacts • Risk Assessment and Management • Identifying Hazards in the Workshop • Conducting Risk Assessments • Implementing Control Measures • Regular Safety Audits and Inspections • Personal Protective Equipment (PPE) • Types of PPE Required in Workshops • Proper Use and Maintenance of PPE • Training on PPE Usage • Safe Handling and Storage of Materials • Handling Hazardous Materials • Proper Storage Techniques • Labeling and Documentation • Machinery and Equipment Safety • Safe Operating Procedures for Workshop Machinery • Regular Maintenance and Inspection • Lockout/Tagout Procedures • Ergonomics in the Workshop • Importance of Ergonomics • Ergonomic Best Practices • Preventing Musculoskeletal Disorders • Fire Safety • Fire Prevention Strategies • Types and Use of Fire Extinguishers • Evacuation Plans and Drills	• Observation • Oral interview • Portfolio • Third part reports • Project work • Research project • Written tests • Individual and group presentations

	• Electrical Safety • Safe Use of Electrical Equipment • Identifying Electrical Hazards • First Aid for Electrical Injuries • Chemical Safety • Handling and Storing Chemicals Safely • Understanding Safety Data Sheets (SDS) • Spill Response Procedures • Noise and Vibration Control • Identifying Sources of Noise and Vibration • Measures to Reduce Exposure • Hearing Protection • Housekeeping and Workplace Organization • Importance of Good Housekeeping • Techniques for Maintaining a Clean and Organized Workshop • Waste Management and Disposal • Health and Wellness • Promoting Physical and Mental Health in the Workplace • Recognizing Signs of Fatigue and Stress • Implementing Wellness Programs • Accident and Incident Reporting • Procedures for Reporting Accidents and Near Misses • Investigating Incidents • Implementing Corrective Actions • Emergency Preparedness • Preparing for Emergencies (e.g., Fire, Medical) • Emergency Equipment and Supplies • Conducting Regular Drills	

2. Perform engineering measurements	• Introduction
	  • Overview of the importance of measuring tools and equipment in a workshop
	  • Techniques for accurate measurement
	• Categories of Measuring Tools
	  • Dimensional measurement tools
	  • Force and torque measurement tools
	  • Temperature measurement tools
	  • Electrical measurement tools
	  • Surface and hardness measurement tools
	• Dimensional Measurement Tools
	  • Rulers and Measuring Tapes
	  • Steel rulers
	  • Flexible measuring tapes
	  • Calipers
	  • Vernier calipers
	  • Digital calipers
	  • Dial calipers
	  • Micrometers
	  • Outside micrometers
	  • Inside micrometers
	  • Depth micrometers
	  • Gauges
	  • Thickness gauges (feeler gauges)
	  • Radius gauges
	  • Telescoping gauges
	  • Thread pitch gauges
	  • Squares
	  • Engineer's squares
	  • Combination squares
	  • Try squares
	  • Protractors
	  • Basic protractors
		• Observation
		• Oral interview
		• Portfolio
		• Third part reports
		• Project work
		• Research project
		• Written tests
		• Individual and group presentations

	• Digital protractors • Bevel protractors • Levels • Spirit levels • Laser levels • Force and Torque Measurement Tools • Torque Wrenches • Click-type torque wrenches • Beam-type torque wrenches • Digital torque wrenches • Force Gauges • Mechanical force gauges • Digital force gauges • Temperature Measurement Tools • Thermometers • Digital thermometers • Infrared thermometers • Thermocouples • Types of thermocouples • Applications • Temperature Guns • Electrical Measurement Tools • Multimeters • Analog multimeters • Digital multimeters • Clamp Meters • Insulation Testers • Oscilloscopes • Basic functions • Applications • Surface and Hardness Measurement Tools • Surface Roughness Testers • Stylus type • Optical type	

	• Hardness Testers
	  • Rockwell hardness testers
	  • Brinell hardness testers
	  • Vickers hardness testers
	• Specialized Measuring Tools
	
	  • Height Gauges
	  • Vernier height gauges
	  • Digital height gauges
	  • Depth Gauges
	  • Vernier depth gauges
	  • Digital depth gauges
	  • Coordinate Measuring Machines (CMM)
	  • Functionality
	  • Applications
	  • Laser Measuring Tools
	  • Laser distance meters
	  • Laser scanning tools
	• Measurement procedures
	• Maintenance and Calibration
	
	  • Importance of maintaining measuring tools
	  • Calibration procedures for accuracy
	
	  • Storage tips to prevent damage	

3. Carry out bench work and portable grinding operations	• PPEs • Bench work tools, machines and equipment • Grinding machine • Bench work operations • Grinding operations • Preparation of work piece • Inspection of grinding machines • Inspection of bench work tools, machines and equipment	• Observation • Oral interview • Portfolio • Third part reports • Project work • Research project • Written tests

	• Mount grinding wheel
	• Storage of tools and equipment
	• Store records
	• House keeping
	• Overview of grinding machines
	• Types of grinding machines (surface, cylindrical, centerless, etc.)
	• Applications and importance in various industries
	• Machine Components and Functions
	• Major components (grinding wheel, worktable, spindle, etc.)
	• Functions of each component
	• Understanding machine controls and indicators
	• Pre-Operation Checks
	  • Inspecting the grinding wheel for damage
	  • Ensuring guards and safety devices are in place
	  • Verifying machine calibration and setup
	  • Checking for adequate lubrication and coolant levels
	• Setting Up the Grinding Machine
	  • Mounting and balancing the grinding wheel
	  • Aligning the workpiece
	  • Setting the correct speed and feed rate
	  • Adjusting the machine settings for specific tasks
	• Operating Procedures
	  • Starting the machine
	  • Positioning the workpiece
		• Individual and group presentations

	• Engaging the grinding process • Monitoring the operation • Making adjustments during the operation • Grinding Techniques • Types of grinding operations (surface grinding, cylindrical grinding, etc.) • Techniques for achieving desired finishes • Avoiding common grinding defects (burns, chatter, etc.) • Managing heat and stress in the workpiece • Post-Operation Procedures • Properly stopping the machine • Cleaning the machine • Inspecting the finished workpiece • Recording machine usage and maintenance logs • Maintenance and Troubleshooting • Regular maintenance tasks (lubrication, wheel dressing, etc.) • Troubleshooting common issues (vibration, wheel wear, etc.) • When to replace grinding wheels • Record-keeping for maintenance	
4. Apply material safety data sheet information	• Introduction • Product specifications • Material properties • Material risks and hazards • Material data sheet information • Toxicological information of materials • First aid measures according to material data sheet information • Ecological and disposal methods	• Observation • Oral interview • Portfolio • Third part reports • Project work • Research project • Written tests

	• Material safety data sheet
	• Materials
	  • Types of Materials
	  • Metals (steel, aluminum, brass, etc.)
	  • Plastics
	  • Composites
	  • Material Properties
	  • Understanding hardness, ductility, tensile strength, etc.
	  • Selection of Materials
	  • Criteria for choosing appropriate materials for specific tasks
		• Individual and group presentations

5. Perform soldering and brazing	• Definition of terms • PPEs • Types of Soldering and brazing • Soldering and brazing equipment • Soldering and brazing procedures • Workpiece preparation • Assembling bench work tools, machines and equipment • Procedure of updating store records • House keeping	• Observation • Oral interview • Portfolio • Third part reports • Project work • Research project • Written tests • Individual and group presentations
6. Operate hand tools and electrical and electronic measurement equipment	• Introduction • Safety requirements when operating tools • Hand tool, electrical and electronic measurement equipments. • Hand tool, electrical and electronic measurement equipment manufacture's manuals. • Hand tool, electrical and electronic measurement equipments operation. Machine Setup	• Observation • Oral interview • Portfolio • Third part reports • Project work • Research project • Written tests • Individual and group presentations

	• Preparing the Work Area
	• Securing the Workpiece
	• Selecting and Mounting the Cutting Tool
	• Adjusting the Worktable and Ram
	Operating Controls
	
	• Starting and Stopping the Machine
	• Speed and Feed Controls
	• Stroke Length and Position Adjustment
	• Manual and Automatic Operations
	Cutting Operations
	
	• Types of Cutting Operations (e.g., Horizontal, Vertical, Angular)
	• Step-by-Step Guide to Performing a Cut
	• Controlling Cutting Depth and Feed Rate
	• Tools and Equipment
	
	• Hand Tools
	  • Types (files, hacksaws, chisels, hammers, etc.)
	  • Selection criteria
	  • Proper use and handling
	• Measuring and Marking Tools
	  • Types (calipers, micrometers, rulers, marking gauges)
	  • Techniques for accurate measurement and marking
	• Power Tools
	  • Types (drills, grinders, sanders)
	  • Safe operation and handling
	• Maintenance and Storage
	  • Routine maintenance of tools	

	• Proper storage to prevent damage and ensure longevity
	• Basic Operations
	  • Filing
	  • Types of files and their uses
	  • Techniques for effective filing
	  • Sawing
	  • Types of saws and blades
	  • Techniques for accurate sawing
	  • Chiseling
	  • Types of chisels
	  • Techniques for precise chiseling
	  • Drilling
	  • Types of drills and drill bits
	  • Techniques for accurate drilling
	• Advanced Operations
	  • Thread Cutting
	  • Tools and techniques for cutting internal and external threads
	  • Tapping and Die Work
	  • Tools and procedures for tapping and die work
	  • Grinding and Sanding
	  • Types of grinders and sanders
	  • Techniques for achieving smooth finishes
	  • Heat Treatment
	  • Basics of annealing, hardening, and tempering
	• Safety precautions
	• Hand tool, electrical and electronic measurement equipment inspection.	

	• Update store records • House keeping	
7. Maintain Electrical workshop tools and equipment	• Introduction • Types of maintenance • Maintenance procedure for each type • Repair broken tools, machines and equipment • Maintenance reports • Preparation of Maintenance schedule • Preparation of procurement plan • Procurement of tools, machine and equipment and accessories • Costing • Breakeven point • Housekeeping Maintenance and Troubleshooting • Routine Maintenance Procedures • Lubrication Points and Schedule • Identifying and Fixing Common Issues • Replacing Worn or Damaged Parts	• Observation • Oral interview • Portfolio • Third part reports • Project work • Research project • Written tests • Individual and group presentations
8. Carry out Electrical workshop housekeeping practices	• Introduction • Workshop housekeeping activities • Workshop housekeeping procedures • Importance of house keeping • Proper Storage of tools • Segregation and disposal of wastes • Purpose of Bench Work Operations • Definition and importance in manufacturing and repair • Common applications in various industries	• Observation • Oral interview • Portfolio • Third part reports • Project work • Research project • Written tests • Individual and group presentations

Suggested Methods of Instruction:

- Blended/Hybrid learning

- Case study
- Coaching
- Community of practice (CoP) learning strategy
- Cooperative learning (Think, pair, share, and Jigsaw)
- Demonstration by trainer
- Flipped classroom
- Group Discussions
- Industrials visits/ Industrial training practical's
- Inquiry-based Learning
- Instructor-led
- Journaling
- Practical Exercise by the trainee(s)
- Reflective discussion
- Roleplaying
- Self-study

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
Computational Resources (1): • Computers with relevant software for simulations and modeling (e.g., finite element analysis (FEA), computational fluid dynamics (CFD), materials modeling software). • Access to databases and digital libraries for research purposes. **Computers and Workstations (24):**	**Workshop equipment:** • **Workbenches:** Equipped with necessary tools (e.g., vices, clamps) for various tasks. • **Power Tools:** Such as drills, saws, grinders, and sanders. • **Hand Tools:** Spanners, screwdrivers, pliers, hammers, etc. • **Bench Vices:** For holding workpieces securely. • **Measurement Tools:** Calipers, rulers, measuring tapes, etc. • **Safety Equipment:** Gloves, goggles, ear protection, etc.	• **Safety Signage and Instructions** (1 each): • Clear signage indicating safety protocols and emergency procedures. • Instructional posters on proper lathe operation and safety tips. • Flashcards • Flip charts • 2 packets of assorted colors of whiteboard marker pens • Printing papers • Technical Publications: Industry standards,

○ Equipped with necessary software and internet access • Training Workshops and Laboratories (1) • Internet connection • 1 Projector • 1 Printer • 1 Whiteboard • Report writing templates • Interactive Whiteboards (1) • Ship Engine Room Simulator (1) **Training Facility:** • **Workshop Space** (1): • **Power Supply:** ○ Reliable electrical supply with proper voltage and amperage for machines **Qualified Instructors (1):** • Qualified faculty with expertise in workshop practices. **Technical Support Staff (1):** • Technical support staff for maintaining equipment and assisting in experiments	• **Ventilation and Extraction Systems:** For dust and fumes. **Materials and Consumables:** • **Raw Materials:** Wood, metal, plastic, etc., for practical projects. • **Fasteners and Adhesives:** Nuts, bolts, screws, glue, etc. • **Finishing Materials:** Paints, varnishes, abrasives, etc. • **Safety Materials:** First aid kits, fire extinguishers, emergency showers, etc.	manuals, and guidelines from organizations like the International Maritime Organization (IMO) and classification societies (2 each) • Textbooks and References (25 each) **Instructional Materials** (6 each)**:** • Manuals and guides. • Online resources, including videos and tutorials, for supplementary learning • Handout notes (24) **Educational Materials:** • **Textbooks and Manuals (24):** • **Digital Resources (5):** • Online tutorials and video demonstrations • **Training Modules (1):** • Structured curriculum covering theory and practical skills

		• Safety protocols and best practices

MARITIME LEGISLATIONS

UNIT CODE: 0714 541 11A
TVET CDACC UNIT CODE: MET/CU/ETE/CC /08/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Apply maritime legislations.

Duration of Unit: 40 hours

Unit Description
This unit specifies competencies required by Officer in Charge of an Engineering Watch to apply maritime legislations. It involves applying principles of law, applying national maritime legislations, applying safety of life at sea legislation, applying marine environment protection legislation, applying maritime labor legislation, applying maritime training and certification legislation, applying load line legislation, applying maritime security legislation and applying international safety management legislations.

Summary of Learning Outcomes
1. Apply principles of Law
2. Apply National Maritime Legislations
3. Apply Safety of Life at Sea legislation
4. Apply marine environment protection legislation.
5. Apply maritime labour legislation.
6. Apply maritime training and certification legislation.
7. Apply Load line legislation.
8. Apply Maritime Security legislation.
9. Apply international safety management legislations

Learning Outcomes, Content and Suggested assessment methods

Learning Outcomes	Content	Suggested assessment methods
1. Apply principles of Law	• Meaning of law • Evolution of maritime law • Sources of maritime law • Private and public international law • Introduction to maritime conventions	• Oral interview • Project work • Research project • Written tests • Individual and group presentations • Case study

	• Process of ratification of international maritime conventions
	• International maritime organizations
	  • International Maritime Organization (IMO)
	  • International Labour Organization (ILO)
	  • International Telecommunications Union (lTU)
	• Domestication of international maritime conventions
	• Introduction to IMO instruments related to safety of navigation (SOLAS, MARPOL, TONNAGE, LOAD LINES, COLREGS, STCW
	• Keeping track with new developments in Maritime Law
		• Video presentation

2. Apply National Maritime Legislations	• Rule of law • Fundamental rights and freedom • Composition of the judiciary and hierarchy of Kenyan courts • Composition and jurisdiction of administrative tribunal in Kenya • National maritime legislation that apply to ships and its personnel	• Oral interview • Project work • Research project • Written tests • Individual and group presentations • Case study • Video presentation

	• Organisations responsible for compliance with international maritime legislation • Issuance of certificates and endorsement • Provisions for granting dispensation of certificates • Functions of the port State, flag State and Coastal State in enforcing maritime conventions • Ship registration and licensing • Operations and maintenance in accordance with national legislative requirements. • Renewal and extension of certifications to ensure continued validity.	

3. Apply Safety of Life at Sea legislation	• Historical development of SOLAS Convention
	• Terms used in the Convention
	• General provisions of SOLAS
	• Harmonized surveys and certification (HSCS)
	• Surveys to which a passenger ship must be subjected
	• Responsibility for carrying out surveys
	  • Nominated surveyors
	  • Recognised Organizations
	• Certificates issued after
		• Oral interview
		• Project work
		• Research project
		• Written tests
		• Individual and group presentations
		• Case study
		• Video presentation

	survey to ships satisfying the requirements of SOLAS and validity of each of the certificates • Provisions for carriage of dangerous goods in bulk in solid form • Provisions for carriage of dangerous goods bulk in liquid form • Provisions for special requirements for construction of ships and equipment for carriage of packed cargo • Monitoring of shipboard operations in compliance with company operational procedures and regulatory requirements. • Application of the 'no more favorable treatment' clause in accordance with the SOLAS Convention • Obligations of flag States, port States and coastal States in accordance with SOLAS • Potential non-compliance identified and promptly reported in accordance with Company procedures and legislation • Records prepared and maintained in accordance with regulatory and company requirements.	

4. Apply marine environment protection legislation	• Historical development of MARPOL • Terms used in the MARPOL Convention • General provisions of MARPOL • Regulatory requirements and approvals which apply to ships under MARPOL • Crew awareness of their legislative obligations and responsibilities with respect to marine environment protection • Monitoring of compliance against company operational procedures and regulatory requirements. • Inspections conducted to monitor compliance against company and regulatory requirements. • Certification requirements under MARPOL • Application of the 'no more favorable treatment' clause in accordance with the MARPOL Convention • Obligations of flag States, port States and coastal States in accordance with MARPOL • Identification of potential non-compliance reporting in accordance with company procedures and legislation • Records prepared and maintained in accordance	• Oral interview • Project work • Research project • Written tests • Individual and group presentations • Case study • Video presentation

	with regulatory and company requirements.	
5. Apply maritime labour legislation.	• Historical development of Maritime Labour Convention (MLC) • Terms used in the MLC Convention • General provisions of MLC • Regulatory requirements and approvals that apply to ships in accordance with MLC • Rights of seafarers • Obligations of flag States, port States and labour supplying countries in accordance with MLC • Responsibilities of ship-owners based on MLC and national requirements. • Responsibilities of recruitment and placement agents for seafarers based on MLC and national requirements. • Monitoring and compliance of Ships in accordance with Maritime Labour requirements • Application of the 'no more favorable treatment' clause in accordance with the MLC • Identifying potential non-compliance and reporting in accordance with maritime labour regulations • Complaint procedure in accordance with company	• Oral interview • Project work • Research project • Written tests • Individual and group presentations • Case study • Video presentation

	requirements and regulations • Records prepared and in accordance with regulatory and company requirements.	
6. Apply maritime training and certification legislation.	• Historical development of the International Convention on the Standards of Training, Certification and Watchkeeping for Seafarers (STCW) Convention • Terms used in the STCW Convention • Provisions of STCW Convention • Purpose of the Conventions • Maritime Training and certification legislative and regulatory requirements • Control of issuance of certificates and endorsement • Provisions for granting dispensation of certificates • Control functions of the port States in enforcing the provisions of the Convention • Obligations of the flag State maritime training and certification legislation. • Legislative requirements of a ship in accordance with the STCW Convention and national regulatory requirements	• Oral interview • Project work • Research project • Written tests • Individual and group presentations • Case study • Video presentation

	• Application of the 'no more favorable treatment' clause in accordance with the STCW Convention • Reporting non-compliance in accordance with company procedures and national legislative requirements • Maintain required records in accordance with regulatory and company requirements.	

7. Apply Load line legislation	• Historical development of Load line Convention, 1966
	• Terms applied in the Convention
	• Load Line regulation
	  • Freeboard
	  • Freeboard deck
	  • Superstructure
	• Provisions for stowage of deck cargo
	• Load line convention requirements and approvals that apply to the ship
	• Certification requirements for certification
	• Maintenance of records in accordance with regulatory and company requirements.
		• Oral interview
		• Project work
		• Research project
		• Written tests
		• Individual and group presentations
		• Case study
		• Video presentation

8. Apply Maritime Security legislation.	• Development of the amendment to SOLAS Chapter XI-II • Terms used in ISPS Code • Objectives of the ISPS Code • Responsibilities of contracting Governments under the Code	• Oral interview • Project work • Research project • Written tests • Individual and group presentations • Case study

	• Concept of declaration of security
	• Obligations for the ships and company
	• Control mechanisms provided under the Code
	• Alternative security arrangements
	• National regulatory framework for maritime security
	  • Approvals that apply to the ship and port facilities
	  • Obligations of the flag State in accordance with the ISPS Code
	  • Monitoring of compliance under the Code
	  • Identifying potential non-compliance is identified and reporting in accordance with Company procedures.
	  • Certification requirements under the ISPS Code
		• Video presentation

9. Apply international safety management legislations	• Historical evolution of the ISM Code • Legislative and regulatory requirements for ships in accordance with the ISM Code -passenger ships - tankers and bulk carriers of 500gt and upwards • Responsibility of the Master and ship's	• Oral interview • Project work • Research project • Written tests • Individual and group presentations • Case study • Video presentation

	personnel in accordance with the ISM Code • Inspections are conducted to monitor compliance against company and regulatory requirements. • Opportunities and recommendations for improvements are reported. • Required records are prepared and maintained in accordance with regulatory and company requirements.	

Suggested Methods of Instruction:

- Blended/Hybrid learning
- Case study
- Coaching
- Community of practice (CoP) learning strategy
- Cooperative learning (Think, pair, share, and Jigsaw)
- Demonstration by trainer
- Flipped classroom
- Group Discussions
- Industrials visits/ Industrial training practical's
- Inquiry-based Learning
- Instructor-led
- Journaling
- Practical Exercise by the trainee(s)
- Reflective discussion
- Roleplaying
- Self-study

Recommended Resources for 24 trainees

SNo.	Resources	Quantity
.1	Whiteboard and marker	1

.2	Projector	1
.3	Laptop	1
.4	A classroom with furniture for 24 students and the facilitator	24
.5	Eight copies of each of the following Conventions: - UNCLOS - International Convention for the Safety of Life at Sea (SOLAS), including: - International Code for the construction and equipment of ships carrying dangerous chemicals in bulk and index of dangerous chemicals carried in bulk (IBC) - Code for the construction equipment of ships carrying Dangerous Chemicals in Bulk (BHC Code) - International Maritime Dangerous Goods Code - International Maritime Solid Bulk Cargoes Code - International Safety Management (ISM) Code - International Convention on Load Lines - International Convention on Tonnage Measurement of Ships - International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) - International Convention for the Prevention of Pollution from Ships (MARPOL) and Protocols - International Convention for the Control and Management of Ships Ballast Water and Sediments - International Convention on the Control of Harmful Anti-Fouling Systems on Ships - International Ship and Port Facility Security (ISPS) Code	8 copies of each

BASIC ENGINEERING SCIENCE

UNIT CODE: 0531 541 12A
TVET CDACC UNIT CODE: MET/CU/ETE/CC /09/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Apply Basic Engineering Principles

Duration of Unit: 50 hours

Unit Description
This unit describes the competencies required by an electro technical officer to apply basic engineering principles to their work. It involves applying knowledge of; mass, density and volume, dynamics, energy, work and power, fluids and Heat.

Summary of Learning Outcomes

1. Apply knowledge of mass, density and volume
2. Apply Knowledge of dynamics
3. Apply knowledge of energy, work and power
4. Apply knowledge of fluids
5. Apply knowledge of heat

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Apply knowledge of mass, density and volume	• Definition of terms and SI units
	  • Volume
	  • Mass
	  • Center of gravity
	  • Density
	  • Relative density
	• Explanations of homogenous masses center of gravity
	• Solving of problems on volume, Mass, density and relative density
	• Measurements of density of liquids using hydrometer
		• Written tests
		• Oral questioning
		• Assignments
		• Supervised exercises

2. Apply Knowledge of dynamics	The relationship between speed, acceleration, mass, force and distance	• Written tests • Oral questioning

	• Definition of distance, speed, displacement, velocity and acceleration and their SI units • Calculation of distance, speed, displacement, velocity and acceleration • Plotting speed-time graphs for straight-line motion and calculating area under the curve. • Plotting of velocity time graphs and calculating area under the curve. • Definition of free fall acceleration as 9.8 m/s^2 • Equations of linear motion • Calculations on motion under gravity e.g free fall, vertical projection, time taken to reach maximum height, time of flight, maximum height reached and velocity of return to point of projection. • Stating that, in order to accelerate a mass, a force has to be applied • The unit of force - Newton (N) • Newton's laws of motion • Define weight as a force caused by gravitational attraction towards the centre of the earth - uses the equation F = ma to solve simple problems • Practical examples of the effect of friction • Define friction • Stating that that force is required to overcome the effects of friction • Explanation in general terms the factors which affect frictional resistance to motion	• Assignments • Supervised exercises

3. Apply knowledge of energy, work and power	• The relationship between forms of energy, work and power • Sources of energy • Define force and SI units • Definition of work as Force * distance travelled; SI Units • Simple problem-solving involving force, distance and work • Define Energy and state its SI units • The relationship between energy and work • Define potential energy and perform calculations • Definition as kinetic energy and derivation of the equation mv2/2 • Relate work done to accelerate an object to its change in kinetic energy • Define inertia • Using given data to draw graphs of force and distance moved and relate to the area under the graph to work done • Examples of the conversion of energy from one form to another • Define power as the rate of transfer of energy or the rate of doing work and its SI units. • Define efficiency in terms of input and output • Simple problem solving relating to power, work and energy.	• Assignments • Oral questioning • Supervised exercises • Written tests • Practical tests
4. Apply knowledge of fluids	The effects of pressure, its relationship to depth of liquid and force • Define fluid • Define pressure • The SI unit of pressure	• Assignments • Oral questioning • Practical tests • Observation • Supervised exercises • Written tests

	• The practical unit of pressure is 10^5 newton/m^2 and is 1 bar
	• Stating that atmospheric pressure is approximately 1 bar
	• Solving problems involving force, area and pressure
	• Stating that the pressure at any level in a fluid is equal in all directions
	• Stating that pressure acts in a direction normal to a surface
	• Stating that the pressure at any level in a liquid depends upon the vertical height to the liquid surface (its head) and the density of the liquid - explains in simple terms what is meant by:
	  • atmospheric pressure
	  • vacuum
	  • partial vacuum
	  • absolute zero pressure
	  • gauge pressure
	• Draw and explain instruments used to measure atmospheric and fluid pressure:
	  • piezometer
	  • manometer
	  • simple barometer
	  • bourdon pressure gauge
	• Solving simple problems involving 9.8 * head * density	

5. Apply knowledge of heat	The relationship between temperature, Heat Energy and Heat Transfer • Meaning of temperature of a substance • Definition of the Celsius scale and its fixed points • Define the Kelvin	• Assignments • Supervised exercises • Written tests • Practical test

	• Measuring temperature, using a mercury-in-glass thermometer
	• Definition of fuel calorific value
	• Solving simple problems, using the equation: heat transfer = mass of fuel x calorific value
	• solving problems involving calorific value, mass of fuel, work done, energy transfer, fuel flow rates and efficiency
	• Define specific heat capacity
	• Solving problems involving mass, specific heat capacity and temperature change
	• Explain the simple terms:
	  • conduction
	  • convection
	  • radiation
	• Examples of heat transfer by each of the processes described.
	• The effect of raising temperature on the physical dimensions of solids, liquids and gases	

Suggested Methods of Instruction

- Group discussions
- Demonstration by trainer
- Exercises by trainee

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
• Laboratory instruments 24 thermometers, hydrometers	• 24 Samples	• Relevant textbooks 1 each
• 1 Whiteboards		• 2 Screen projector

• 1 LCD Projector	• PPE –hand gloves, dust coat, dust masks •	• 10 packets of assorted colors of whiteboard marker pens

INDUSTRIAL CHEMISTRY PRINCIPLES

UNIT CODE: 0532 541 13A
TVET CDACC UNIT CODE: MET/CU/ETE/CC /10/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Apply Industrial Chemistry Principles
Duration of Unit: 40 hours

Unit Description
This unit describes the competencies required by an electro technical officer to apply industrial chemistry principles to their work. It involves applying knowledge of; chemistry fundamentals, alkalinity/acidity, corrosion, water testing and treatment, and, fuels and lubricants

Summary of Learning Outcomes

1. Apply knowledge of fundamental of Industrial chemistry
2. Apply Knowledge of acidity/alkalinity
3. Apply knowledge of corrosion
4. Apply knowledge of water testing and treatment
5. Apply knowledge of fuels and lubricants

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Apply knowledge of fundamentals of Industrial chemistry	• Definition of terms
	  • Atom
	  • Molecule
	  • Chemical elements
	  • Chemical compounds
	  • Elements
	  • Compounds
	  • Mixtures
	  • Chemical reaction
	  • oxides
	• Explanations of:
	  • Solution
	  • Solubility
	  • Saturated solution
		• Written tests
		• Oral questioning
		• Assignments
		• Supervised exercises

	• Suspension • Precipitation • The convention denoting elements, compounds and mixtures by letters	
2. Apply Knowledge of acidity/alkalinity	• Composition of an atom • Result of atom gaining or losing electrons • Definition of hydrogen ion • Definition of hydroxyl ion • Interpret PH values • Use of indicators to determine alkalinity or acidity	• Written tests • Oral questioning • Assignments • Supervised exercises
3. Apply knowledge of corrosion	• Forming of metallic hydroxides • Definition of the effect of dissolved oxygen and high acidity on polarization • States that boiler water should be alkaline and contain little or no dissolved oxygen • Explanation of the fundamental process of corrosion • Name common engineering materials which produce passive oxide films • State the main cause of corrosion • Name the components of a galvanic cell and application to the corrosion of a metal • Sea water as an electrolyte • Definition of anode • List of common metals: selection of relative anodes • Definition of metals as being noble or base relative to each other • Use of sacrificial anodes • Problems when graphite grease is used when seawater is present	• Assignments • Oral questioning • Supervised exercises • Written tests • Practical tests

	• Practical means of reducing galvanic action in the choice of metal and exposed surface area
	• Define pitting corrosion
	• The process of graphitization of cast iron
	• The reasons why corrosion increases when seawater velocity increases
	• Definition of terms and what is meant by stress corrosion and names of metals in which it commonly occurs
	• What is meant by dezincification and de-aluminification
	• How the process in the dezincification and de-aluminification can be prevented
	• What is meant by fretting corrosion
	• Factors which increase the rate of fretting
	• What is meant by corrosion fatigue
	• Major factors affecting the corrosion process as:
	  • differential temperatures
	  • stresses within the metal structure
	  • variation in crystal structure of the metal
	  • distribution/concentration of impurities in the metal crystals
	  • flow of oxygen to the cathode
	  • flow of carbon dioxide to the anode and cathode
	  • hydroxyl ion concentration of the aqueous solution
	• Recognition that some films and coatings on metal surfaces can provide protection so long as they remain intact	

	• Recognition that surface preparation prior to the application of protective coatings is very important
	• Identify the important methods of surface protection as:
	  • paints
	  • chemical films
	  • metallic coatings
	  • anodizing	

4. Apply knowledge of water testing and treatment	• The importance of controlling the pH value of aqueous solutions within the minimum corrosive range
	• Identification of the chemical additives that can be used to obtain the condition required to control PH value of aqueous solutions.
	• The importance of maintaining a gas-free condition in the water used to "feed" a steam boiler or to circulate in an engine cooling system
	• Methods used for conditioning the water content of marine power plant, e.g. tri-sodium phosphate, hydrazine
	• Method of measuring metallic salt content, i.e. state the actual quantity of metallic salt present in a specified quality of water
	• The standard measurement given in the above objective as in units of "parts per million" (ppm) or less accurately in '32's' (seawater density measurement)
	• List of the main metallic salts found in:
	  • fresh water
	  • average seawater
	• Definition of:
		• Assignments
		• Oral questioning
		• Practical tests
		• Observation
		• Supervised exercises
		• Written tests

	• permanent hardness • temporary hardness • How scale and sludge are produced in a steam boiler • The different effects of using seawater, fresh water and distilled water as boiler feedwater • Objects of treating of boiler feedwater	
5. Apply knowledge of fuels and lubricants	• Identification of the average carbon, hydrogen, sulphur and ash content of the following fuels: • petrol • kerosene • marine diesel fuel • boiler fuel oil • Definition of flashpoint and its importance for marine fuels and lubricants • Knowledge of flashpoint temperature for the following hydrocarbons: • petrol • kerosene • marine diesel fuel • boiler fuel oil • lubricating oil • Identification of the minimum closed flashpoint of marine fuels • The maximum temperature to which fuel oil may be raised • Description of the precautions taken on board ship to prevent accidental ignition of the oils listed in the above objective • Definition of viscosity in terms of resistance to flow	• Assignments • Supervised exercises • Written tests • Practical test

	• Demonstration of why it is necessary to raise the temperature of some fuel oils
	• Carry out tests on fuels and lubricants for:
	  • flashpoint
	  • viscosity
	• Explanation of why values of flashpoint or of viscosity need to be known for the following:
	  • fuels and lubricants in storage
	  • transfer of fuels and lubricants
	  • carrying out tests on fuels and lubricants for water content
	Energy changes	

Suggested Methods of Instruction

- Group discussions
- Demonstration by trainer
- Exercises by trainee

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
• Laboratory instruments 6 thermometers, hydrometers	• 24 Samples	• Relevant textbooks 1 each • Relevant reference materials 1 each • Relevant practical materials 1 each
• 1 Whiteboards		• 2 Screen projector
• 1 LCD Projector	• PPE –hand gloves, dust coat, dust masks •	• 10 packets of assorted colors of whiteboard marker pens

CORE UNITS OF LEARNING

MARINE ELECTROTECHNOLOGY SYSTEMS

UNIT CODE: 0714 551 14A

TVET CDACC UNIT CODE: MET/CU/ETE/CR /01/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Operate marine electrotechnology system.

Duration of Unit: 240 hours

Unit Description

This unit specifies competencies required by an electro technical officer to operate marine electrotechnology systems. It involves performing safe electrical practices, operating electrical and electronic equipment, operating electrical motors, operating computers and computer networks, and operating corrosion prevention equipment.

Summary of Learning Outcomes

1. Perform safe electrical practices
2. Operate electrical and electronic equipment
3. Operate electrical motors
4. Operate computers and computer networks
5. Operate corrosion prevention equipment

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested assessment Methods

1. Perform safe electrical practices	• Safety hazards on shipboard electrical equipment
	  • electric shock,
	  • arc blast,
	  • transient overvoltage,
	  • movable (rotating) parts,
	• Personal Protective Equipment (PPE)
		• Observation
		• Oral questioning
		• Written tests
		• Practical tests

	• coveralls, • safety or insulation shoes, • safety glasses or full-face shield, • insulation gloves, • insulation mates, • hearing protection equipment, safety harness, • hard hat, • rubber apron, • dust mask • Basics of electricity • Current • Voltage • Current • Resistance • Lockout - Tagout procedures • Job Safety Analysis (JSA) • Work Permit System • Earthing devices • Fixed earthing devices • Portable earthing devices • Electrical circuits • Safety circuit and safety functions • Insulators and conductors • Electrical isolation • Maintenance schedules • SOLARS	
2. Operate electrical and electronic equipment	• Safety requirements • Safety hazards • Personal Protective Equipment (PPE) • Work Permit System and Lockout-Tagout procedures	• Observation • Oral questioning • Written tests • Practical tests

	• Maintenance and repair of electrical system equipment, switchboards, electric motors, generators and DC electrical system and equipment
	  • Types of maintenance
	  • Maintenance and repair of switchboards and their associated equipment
	  • Maintenance and repair of DC electrical systems and their associated equipment
	  • Maintenance of batteries
	• Detection of electric malfunction, location of faults and measures to prevent damage
	  • Methods of the detection of malfunction of electrical equipment and electrical systems
	  • Detection of electric malfunction, location of faults and measures to prevent damage
	  • Construction and operation of electrical testing and measuring equipment
	  • Interpretation of measurement results
	• Construction and operation of electrical testing and measuring equipment
	  • Fixed instruments, digital and analogue:
	  • Multimeter
	  • Insulation tester	

	• Oscilloscope
	• Function, configuration and performance tests of monitoring systems, automatic control devices, protective devices
	  • Calibrators, simulators, validators of temperature sensors (Pt-100, THC)
	  • Pressure calibrators
	  • Inspection, troubleshooting, reparation, calibration and configuration of measurement and control lines in the distributed monitoring and control systems (temperature, pressure, level, voltage, current, frequency, etc)
	  • Inspection of the fire-detection systems
	  • Alarms system
	  • Span gas
	• Interpretation of electrical and electronic diagrams
	  • Electrical and electronic graphic symbols used in the diagrams
	  • Types of electrical and electronics diagrams
	  • Technical documentation of ship equipment and machinery
	  • Methods of interpretation of electrical and electronic diagrams	

3. Operate electrical motors	• Introduction
	  • Overview of electrical motors
	  • Types of electrical motors
	  - AC motors
	  - DC motors
	  - Special motors
	• Construction and operation
	  • Basic components of an electric motor
	  - Stator
	  - Rotor
	  - Windings
	  • Principles of electromagnetic induction
	  • Motor torque and speed characteristics
	• Motor control
	  • Starter circuits
	  - Direct-on-line
	  - Star-delta
	  - Soft starters
	  • Speed control methods
	  - Variable frequency drives
	  - Pole changing
	  • Protection devices
	  - Overload relays
	  - Fuses
	  - Circuit breakers
	• Maintenance and troubleshooting
	  • Preventive maintenance tasks
	  • Common motor problems and troubleshooting step
	• Applications
		• Observation
		• Oral questioning
		• Written tests
		• Practical tests

	• Industrial applications
	• Commercial applications
	• Domestic applications
	• Energy efficiency
	  • Energy-efficient motor design and selection
	  • Variable speed drives and their role in energy savings
	  • Motor efficiency standards and regulations	

4. Operate computers and computer networks	• Introduction to computer networks
	• Key components of computer network
	  • Modem
	  • Router
	  • Switch
	  • Server
	  • Cables
	  • Peripherals
	• Main features of data processing
	  • Data types and data description methods in digital systems
	  • Computer or PLC work memory structure
	  • Memory access: byte access, word access
	  • bit - data processing, logical functions, bit memories, time functions, counters, edges	

	• Boolean Algebra and its use for logic circuits • byte and word data processing, logical functions, memory operations: move, shift, rotate, compare • measurement data storage principles and methods, operations on stored measurements • PLC and PC program structures: subroutines, interrupts, sequential control relays • combinatorial systems, system logic functions, output functions, • combinatorial systems, system logic functions, output functions, block diagrams of system functions • sequential control system using graphs and diagrams • digital PID Control method, controller parameters, interrupt processing of control loops • filtering of measurement data and smoothing methods, smoothing factor • Data collection, preparation, input, processing, output, storage • Construction and use of computer networks on ships	

	• industrial networks in process control, their purpose and structures • OSI/ISO Model, nodes functions • basic binary codes in data exchange • serial transmission data busses, RS 232, RS 422, RS 485, cable connectors and terminators • Internet and Ethernet protocols: OSI/ISO, TCP/IP • medium access methods: master, slave master-slave with cyclical polling, token ring, token ring with master-slave polling, CSMA/CD, CSMA/CA • Profibus DP network, nodes, structures, objects of configuration, programming of data exchange • Industrial Ethernet network, nodes, structures, configuration, data exchange configured objects: connections, transfers, calls the instructions, principles of data exchange programming • USS network, nodes, structures, configuration, data exchange	

	• characterizes Modbus network, nodes, structures, configured objects • Bridge-based, Engine-room-based and commercial computer use • purpose, construction and functions of Integrated Navigation Systems (for example VMS Sperry) • purpose, structure and functions of Voyage Data Recorder (VDR system) • purpose, structure and functions of Dynamic Positioning System • purpose, construction and operation of ship fuel consumption optimizing systems (e.g. NAPA, ENIRAM) • purpose, structure and functions of PLC or PC based power management systems • purpose, structure and functions of PLC or PC based systems for fuel storage, transport and preparation • purpose, structure and functions of PLC or PC based refrigeration systems • purpose, structure and functions of Electronic	

	Alarm Recorder (e.g. Prilog) • purpose, structure and functions of Computer Systems for critical equipment condition monitoring (for example METALSCAN, SWANTECH) • purpose, structure and functions of Load and Hull - Stress calculation systems • purpose, structure and functions of Load and Hull - Stress calculation systems.	

5. Operate corrosion prevention equipment	• Introduction
	  • Overview of corrosion and its effects
	  • Importance of corrosion prevention
	• Types of corrosion prevention equipment
	  • Cathodic protection
	  - Impressed current system
	  • Anodic protection
	  - Active anode protection
	  - Passive anode protection
	• Monitoring and inspection
	• Standards for corrosion prevention
	• Equipment selection and maintenance
		• Observation
		• Oral questioning
		• Written tests
		• Practical tests

	• Environmental regulations related to corrosion prevention	

Suggested Methods of Instruction

- Demonstration by trainer
- Practice by the trainee
- Field trips
- On-job-training
- Discussions

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
Training Workshops and Laboratories (1)		
24 Desktop computers/laptops	Instrumentation: Sensors, gauges, and meters used to measure operational parameters such as temperature, pressure, speed, and fuel consumption (5 each)	Assorted Flashcards
Internet connection	Personal Protective Equipment (PPE): Safety gear such as gloves, goggles, and ear protection for practical sessions involving machinery operation (24 each)	Flip charts
2 Projector 2 Printer		2 packets of assorted colors of whiteboard marker pens
2 Whiteboard		Printing papers
Report writing templates		Technical Publications: Industry standards, manuals, and guidelines from organizations like the International Maritime Organization (IMO)

		and classification societies (2 each)
Interactive Whiteboards (1)		Textbooks and References (24 each)
Ship Engine Room Simulator (1)		Training manual (6)
Process Control Simulators (5)		Handout notes (24)
High voltage simulator (1)		
Control Room Setup (1)		
Propulsion System Models (5)		
Qualified Instructors: Experienced faculty with expertise in marine engineering, propulsion systems, and control technology (3)		

MARINE ELECTRICAL AND ELECTRONIC SYSTEMS MAINTENANCE

UNIT CODE: 0714 551 15A
TVET CDACC UNIT CODE: MET/CU/ETE/CR /02/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Maintain marine electrical and electronics systems

Duration of Unit: 120 hours

Unit Description
This unit specifies competencies required by an electro technical officer to maintain marine electrical and electronic systems. It entails maintenance of electrical motor starting systems, power distribution systems, motors, generators, high voltage installations, electrical and electronic equipment and energy storage devices.

Summary of Learning Outcomes

1. Maintain electrical motor starting system
2. Maintain electrical power distribution system
3. Maintain electrical motors
4. Maintain electrical generators.
5. Maintain high voltage installation
6. Maintain electrical and electronics equipment
7. Maintain Energy Storage Devices

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Maintain electrical motor starting system	• Introduction • Overview of motor starting systems • Importance of proper motor starting • Types of motor starting systems • Direct-on-line (DOL) starting • Basic operation and applications • Reduced voltage starting	• Written tests • Oral questioning • Practical tests • Observation

	○ Star-delta starting ○ Autotransformer starting ○ Soft starters • Variable Frequency Drive (VFD) starting ○ Principles of VFD operation ○ Benefits and applications • Selection and sizing • Factors to consider when selecting a motor starting system • Sizing and rating considerations • Control and protection • Control circuits for motor starting systems • Protection devices ○ Overload relays ○ Fuses ○ Circuit breakers • Troubleshooting • Common problems/faults with motor starting systems • Troubleshooting steps and corrective actions • Standards for motor starting systems • Installations and maintenance • Safety considerations for motor starting • Recording and reporting maintenance on motor starting systems	
2. Maintain electrical power distribution system	• Basic parameters, processes and environment influences • environmental exposures for electrical devices • typical technical parameters of electric devices – in e.g.: nominal voltage, on-load voltage, test voltage, protection grade, nominal current, peak power, power factor, etc. • process of electrical devices heating while: continues load, intermittent load, part-time load or short circuit load	• Observation • Oral questioning • Written tests

	• electrical arc and electrical arc protection devices • reasons and consequences of short circuit • short circuit tolerance of electrical devices • Power distribution boards • Transmission and distribution of electrical power • Use and purpose of implementation of a "three phase – three wire, insulated neutral system" for shipboard application. • Single line distribution chart • Structural parts of power distribution system: - feeder lines, branch circuits, distribution boards, switchgear boards, tie-breaker boards • Structure of electrical switchboards • Protective devices selectivity • Electrical Devices for Power Distribution • Electrical devices used for power distribution • Structure of automatic circuit breakers, structure of contacts, arc extinguishing methods, dynamic forces working on contacts • Purpose of lightning arrestors • Purpose of voltage transformers and current transformers • Principles of voltage transformers and current transformers and its characteristics • Current to time characteristics of fuses and automatic circuit breakers • Fuses and overload relays • Automatic circuit breaker settings • Purpose of insulation monitoring devices • leakage current to time characteristics, component currents • Cables • Marine cables and wires • Cable marks and identification system	

	• Cross-section of cables considering long-period current tolerance and acceptable voltage drop
	• Cable type and its cross-section for supplying particular electrical device
	• Calculation of voltage drop in particular electrical circuit
	• Basic rules of cable arrangement
	• Rules and purposes of cable shielding
	• Types of electrical distribution systems
	  • Shore based system
	  • Shipboard systems
	  ▪ Insulated neutral system
	  ▪ Earthed neutral system
	• Components of electrical power distribution system
	• Electrical Loads
	  • Essential
	  • Non-essential
	• Electrical Permits to work
	• Arrangement of shipboard electrical power distribution system
	• Types of Faults in shipboard electrical power distribution system
	• Maintenance of electrical power distribution systems
	• Recording and reporting maintenance on electrical power distribution systems	

3. Maintain electrical motors	• Meaning of terms • Electrical safety • Types of motors • Construction of motors • Principle of operations of motors • Motor ratings • Types of Motor protections • Electrical Permits to work • Isolation of electrical motors	• Observation • Oral questioning • Practical tests • Written tests

	• Types of faults on electrical motors • Maintenance of electrical motors • Recording and reporting maintenance on electrical motors	
4. Maintain electrical generators	• Meaning of terms • Electrical safety • Types of Generators • Construction of generators • Principles of operation of generators • Types of Generator protections • Electrical Permits to work • Isolation of electrical generators • Types of faults on electrical generators • Maintenance of electrical generators • Recording and reporting maintenance on electrical generators	• Observation • Oral questioning • Practical tests • Written tests

5. Maintain high voltage installation	• Meaning of terms
	• High Voltage Electrical safety
	• Principles of High Voltage
	• High voltage technology
	  • Nature and forming of electric stresses, electric stresses in laminar structures, surface discharges
	  • Break-down strength of solid dielectrics, discharge mechanism in solids
	  • Overvoltage and surge protection methods and devices
	  • Ships HV systems: HV apparatus, cables, electrical machines, switchboards, fuses, etc.
	• Safety precautions
	  • HV measurement and control equipment and apparatus#
	  • Ageing of electrical insulation
	  • Testing of electrical insulation strength
	• Electrical propulsion of the ships, electrical motors and control systems
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

	• Electric propulsion configuration and components • Electric motors and frequency drives used in ship propulsion systems • Methods of el. motor control used in ship propulsion systems • Isolation of high voltage installation • Electrical Permits to work for high voltage • Types of faults on high voltage installations • Safe Operation and Maintenance of high-voltage systems • Personal safety equipment for HV works • Testing equipment for HV works • Safety procedures for HV works. • Recording and reporting maintenance on high voltage installations	
6. Maintain electrical and electronics equipment	• Meaning of terms • Electrical safety • Types of electrical and electronics equipment • Principles of operation of electrical and electronics equipment • Electrical Permits to work • Isolation of electrical and electronics equipment Types of faults on electrical and electronics equipment • Maintenance of electrical and electronics equipment • Recording and reporting maintenance on electrical and electronics equipment	• Observation • Oral questioning • Practical tests • Written tests
7. Maintain Energy Storage devices	• Introduction • Overview of energy storage technologies • Importance of proper maintenance for energy storage devices • Types of energy storage devices • Batteries • Supercapacitors • General maintenance	• Observation • Oral questioning • Practical tests • Written tests

	• Inspections and cleaning • Monitoring and data analysis • Temperature and humidity control • Battery maintenance • Battery charging and discharging cycles • Battery capacity testing • Battery equalization and balancing • Battery replacement and disposal • Supercapacitor maintenance • Capacitance and resistance testing • Leakage current monitoring • Temperature monitoring • Safety precautions • Electrical hazards • Chemical hazards • Troubleshooting • Common problems with energy storage devices • Troubleshooting steps and corrective actions • Standards for energy storage device maintenance • Installation and operation • Environmental regulations related to energy storage device disposal • Maintenance of energy storage devices • Recording and reporting maintenance on energy storage devices	

Suggested Methods of Instruction

- Demonstration by trainer
- Practice by the trainee
- Field trips
- On-job-training
- Discussions

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
Training Workshops and Laboratories (1)	• 4 Power tools • 4 Cutting tools • 24 Pliers • 6 Lifting and tensioning tools • 6 Toolbox sets • 6 Phase tester • 24 Multimeter • 24 Clamp meter • 6 Earth electrode resistance meter • 6 Phase sequence meter • Manuals	Motor Starters with starter circuit diagram • 5 Service manuals • 5 IEE regulations • 5 Organization procedures manual • 5 EHS regulations • 5 OSHA regulations
12 Desktop computers/laptops		• Flashcards
Internet connection	24 Sets of Personal Protective Equipment (PPE): Safety gear such as gloves, goggles, and ear protection for practical sessions involving machinery operation (24 each)	• Flip charts
1 Projector 1 Printer		• 2 packets of assorted colors of whiteboard marker pens
1 Whiteboard		• Printing papers
Report writing templates		• Technical Publications: Industry standards, manuals, and guidelines from organizations like the International Maritime

		Organization (IMO) and classification societies (2 each)
Interactive Whiteboards (1)		• Textbooks and References (24 each)
Simulator (1)		• Training manual (6)
• engine room simulators (1) • cargo handling systems simulators (1) • electro-hydraulic and electro-pneumatic systems simulators (1) • electric power plant simulators (1)	• 6 Generators, • 6 motors, • 6 transformers • 24 PCBs • 6 Electric motors • 12 Circuit breakers	• Handout notes (24)
High voltage simulator (1)		• Audio-visual materials
• 6 A.C. and D.C. motor starters and speed control systems • (1)		
L.V. main switchboard		

EMERGENCY EQUIPMENT MAINTENANCE

UNIT CODE: 0714 551 16A
TVET CDACC UNIT CODE: MET/CU/ETE/CR /03/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Maintain Emergency Equipment

Duration of Unit: 50 hours

Unit Description
This unit specifies competencies required by an electro technical officer to maintain emergency equipment. It involves maintenance of portable firefighting equipment, emergency bilge pumping systems, fixed fire-fighting systems, survival craft machinery and fire detection systems

Summary of Learning Outcomes
1. Maintain portable firefighting equipment
2. Maintain emergency bilge pumping systems
3. Maintain fixed firefighting system
4. Maintain survival craft machinery
5. Maintain fire detection systems

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Maintain portable firefighting equipment	• Introduction
	  • Importance of portable firefighting equipment
	  • Types of portable firefighting equipment
	• General maintenance
	  • Regular inspections
	  • Cleaning and decontamination
	  • Storage and handling
	• Specific equipment maintenance
	  • Fire extinguishers
	  - Inspection and testing
	  - Recharging and replacement
	  • Fire blankets
	  - Inspection and replacement
		• Observation
		• Oral questioning
		• Written tests
		• Practical tests

Learning Outcome	Content	Suggested Assessment Methods
	• Operation and maintenance of potable firefighting systems • Record keeping	

2. Maintain emergency bilge pumping systems	• Introduction
	  • Importance of emergency bilge pumping systems
	  • Types of emergency bilge pumping systems
	• General maintenance
	  • Regular inspections
	  • Testing and activation
	  • Cleaning and debris removal
	  • Battery maintenance
	• Specific system maintenance
	  • Pump inspection
	  • Impeller inspection
	  • Hose and pipe inspection
	  • Float switch maintenance
	  • Electrical system maintenance
	• Maintenance tasks
	  • Monthly maintenance
	  • Quarterly maintenance
	  • Annual maintenance
	• Troubleshooting
	  • Common problems with emergency bilge pumping systems
	  • Troubleshooting steps
	• Maintenance practices for optimal system performance
	• System components
	• Safety
	  • Safety precautions when working on emergency bilge pumping systems
	  • Emergency procedures in case of system failure
		• Observation
		• Oral questioning
		• Written tests
		• Practical tests

Learning Outcome	Content	Suggested Assessment Methods

3. Maintain fixed firefighting system	• General maintenance
	  • Inspections
	  • Testing and activation
	  • Cleaning
	  • Battery maintenance
	• Specific system maintenance
	  • Water sprinkler systems
	  - Valve and sprinkler head inspection
	  - Pipe and pipe fitting inspection
	  - Water supply maintenance
	• Foam systems
	  • Foam concentrate maintenance
	  • Piping and nozzle inspection
	  • Proportioning system maintenance
	• Gas suppression systems
	  • Cylinder inspection
	  • Piping and nozzle inspection
	  • Detection system maintenance
	• Other systems
	  • Fire hydrants and hoses
	  • Smoke and heat detectors
	  • Fire alarm systems
	• Operation and maintenance of fixed firefighting systems
	• Record keeping
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

4. Maintain survival craft machinery	• General maintenance
	  • Inspections
	  • Lubrication and greasing
	  • Cleaning and debris removal
	  • Battery maintenance
	• Specific machinery maintenance
	  • Engines
	  • Generator
	  • pumps
	  • Lights
		• Written tests
		• Oral questioning
		• Practical tests
		• Observation

Learning Outcome	Content	Suggested Assessment Methods

	• Other machinery maintenance
	  • Lifeboats and davits
	  • Watermakers
	  • Navigation and communication system
	• Operation and maintenance of survival craft machinery
	• Record keeping	

5. Maintain fire detection systems	• System overview
	  • Types of fire detection systems
	  • Components of a fire detection system
	  • System operation and functionality
	• Inspection and testing procedures
	  • Monthly visual inspections
	  • Quarterly functional testing
	  • Annual comprehensive inspection
	  • Detector cleaning and maintenance
	• Troubleshooting and repair
	  • Common fire detection system problems
	  • Troubleshooting techniques
	  • Repair procedures and safety precautions
	• Record keeping and documentation
	  • Importance of maintenance records
	  • Types of maintenance records
	  • Documentation requirements
	• Emergency response and system integration
	  • Role of fire detection systems in emergency response
	  • Integration with other safety systems
	  • Evacuation procedures and communication
	• Standards and regulations
	  • Relevant fire codes and standards
	  • Insurance requirements
	  • Legal responsibilities
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

Learning Outcome	Content	Suggested Assessment Methods

	• Safety and best practices
	  • Electrical safety precautions
	  • Working at heights
	  • Use of personal protective equipment (PPE)
	  • Emergency procedures	

Suggested Methods of Instruction

- Demonstration by trainer
- Practice by the trainee
- Field trips
- Discussions

Recommended Resources for 24 Trainees

General Resources	Tools and Equipment	Materials and Supplies
Training Workshops and Laboratories (1)	• 24 Multimeter • 6 Electric motors • 24 Testers • 24 Circuit breakers • 6 Manufacturers' Manuals • Assorted	Motor Starters with starter circuit diagram
12 Desktop computers/laptops	Instrumentation: Sensors, gauges, and meters used to measure operational parameters such as temperature, pressure, speed, and fuel consumption (5 each)	• Flashcards
Internet connection	Personal Protective Equipment (PPE): Safety gear such as gloves, goggles, and ear protection for practical sessions involving machinery operation (24 each)	• Flip charts
• 2 Projector • 2 Printer		• 2 packets of assorted colors of

		whiteboard marker pens
2 Whiteboards		Printing papers
Report writing templates		Technical Publications: Industry standards, manuals, and guidelines from organizations like the International Maritime Organization (IMO) and classification societies (2 each)
Interactive Whiteboards (1)		Textbooks and References (24 each)
Simulator (1)		Training manual (6)
Electronic Circuit experiment equipment (1)		Handout notes (24)
High voltage simulator (1)		Audio-visual materials
Models of AC and DC generators (1)		
Marine Switchboard		

CONTROL SYSTEMS OF SHIPBOARD MACHINERY

UNIT CODE: 0714 551 17A
TVET CDACC UNIT CODE: MET/CU/ETE/CR /04/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Monitor control Systems of shipboard Machinery

Duration of Unit: 210 hours

Unit Description

This unit covers competencies required to Monitor control Systems of shipboard Machinery. Competencies include; Monitoring the operation of propulsion machinery control systems, air compressor control systems, steering gear control systems, fuel and lubricating oil control systems, purifier control systems, air conditioning control systems, refrigeration plant control systems, cooling control systems and boiler and steam control systems.

Summary of Learning Outcomes

1. Monitor the operation of propulsion machinery control systems
2. Monitor the operation of air compressor control systems
3. Monitor the operation of steering gear control systems
4. Monitor the operation of fuel and lubricating oil control systems
5. Monitor the operation of purifier control systems
6. Monitor the operation of air conditioning control systems
7. Monitor the operation of refrigeration plant control systems
8. Monitor the operation of cooling control systems
9. Monitor the operation of boiler and steam control systems

Learning Outcomes, Content and Suggested Assessment Methods:

Learning Outcome	Content	Suggested Assessment Methods
1. Monitor the operation of propulsion machinery control systems	• Appropriate PPE • Fundamentals of Control • Control theory and Control Action	• Written tests • Oral questioning • Practical tests • Observation

Learning Outcome	Content	Suggested Assessment Methods
	• Proportional Integral Derivative (PID) Controller • Programmable Logic Controller (PLC) • Structure and principles of PLC • Programmable automatic controllers • Calibration • Controller Algorithm and Controller tuning • Final Control Element • Fail safe • Principles of industrial sequence control • Properties of different types of propulsion system • Components of propulsion systems • Operation checklist • Operation parameters • Communication with bridge • Records and reports on propulsion system	
2. Monitor the operation of air compressors control system	• Appropriate PPE • Safety practices • Interpretation of PLC/PID automatic control system of control air system • Description of types of air compressors • Components of air compressor control systems • Parameters of air compressors • Alarms and abnormalities • Communication with bridge	• Observation • Oral questioning • Practical tests • Written tests

Learning Outcome	Content	Suggested Assessment Methods
	• Recording and Reporting procedures	
3. Monitor the operation of steering gear control systems	• Appropriate PPE • Safety practices • Interpretation of PLC/PID automatic control system of steering gear system • Description of types of steering gear • Components of steering gear system • Parameters of steering gear system • Steering maintenance methods • Steering systems inspections • Alarms and abnormalities • Communication with bridge • Recording and Reporting procedures	• Observation • Oral questioning • Practical tests • Written tests
4. Monitor the operation of fuel and lubricating oil control systems	• Appropriate PPE • Safety practices • Interpretation of PLC/PID automatic control system of fuel and lubricating oil systems • Types of marine fuels and lubricating oils • Properties of different types of marine fuels and lubricating oils • Components of fuel and lubricating oils systems	• Observation • Oral questioning • Practical tests • Written tests

Learning Outcome	Content	Suggested Assessment Methods
	• Viscosity Control • Fuel and lubricating Oil temperature control • Automatic control system for Fuel oil purifiers • Parameters of fuel and lubricating oils • Alarms and abnormalities • Recording and Reporting procedures	
5. Monitor the operation of purifier control systems	• Appropriate PPE • Safety practices • Interpretation of PLC/PID automatic control system of fuel and lubricating oil systems • Types of marine purifiers • Types of marine oils • Properties of different types of marine fuels oils • Components of purifier control systems • Viscosity Control • Fuel Oil temperature control • Automatic control system for Fuel oil purifiers • Parameters of purifier systems oils • Operation of purifiers • Alarms and abnormalities • Recording and Reporting procedures	• Observation • Oral questioning • Practical tests • Written tests
6. Monitor operation of air conditioning control systems	• Appropriate PPE • Safety practices • Interpretation of PLC/PID automatic control system of air conditioning systems	• Observation • Oral questioning • Practical tests • Written tests

Learning Outcome	Content	Suggested Assessment Methods
	• Description of automatic control systems of air conditioning plant • Starting and stopping procedures for automatic control systems of air conditioning • Parameters of air conditioning systems • Operation of air conditioning systems • Alarms and abnormalities • Recording and Reporting procedures	
7. Monitor the operation of refrigeration plant control system	• Appropriate PPE • Safety practices • Interpretation of PLC/PID automatic control system of refrigeration plant systems • Description of automatic control systems of refrigeration plant • Starting and stopping procedures for automatic control systems of refrigeration plant • Parameters of refrigeration plant systems • Operation of refrigeration plant systems • Alarms and abnormalities • Recording and Reporting procedures	• Observation • Oral questioning • Practical tests • Written tests
8. Monitor the operation of cooling control systems	• Appropriate PPE • Safety practices • Interpretation of PLC/PID automatic control system of cooling system • Description of cooling controls	• Observation • Oral questioning • Practical tests • Written tests

Learning Outcome	Content	Suggested Assessment Methods
	• Safe isolation of cooling system controls • Description of automatic control systems cooling system • Starting and stopping procedures for automatic control systems of cooling system • Parameters of cooling systems • Operation of cooling systems • Alarms and abnormalities • Recording and Reporting	

9. Monitor the operation of boiler and steam control systems	• Appropriate PPE
	• Safety practices in steam production
	• Interpretation of PLC/PID automatic control system of control air system
	• Description of the construction and operation of steam boilers
	• Description of automatic steam production control
	  • Water Level control
	  • Combustion control
	  • Burner management
	• Parameters of boiler and steam systems
	• Operation of boiler and steam systems
	• Alarms and abnormalities
	• Recording and Reporting
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests
		•

Suggested Methods of Instruction

- Projects
- Demonstration by trainer

- Practice by the trainee
- Field trips
- On-job training
- Discussions

Recommended Resources
Industrial automation components

- 10 Computers,
- 10 PLCs
- 2 Programming software
- 6 Power control devices
- 6 Sensors and transducers
- 6 Insulation resistance tester
- 6 Automatic control system
- 6 Transducers
- 6 PID controllers
- 6 PLC controllers
- 6 Level PID controllers.
- 6 Flow PID controllers.
- 6 Pressure sensors and transmitters

Tools and equipment

- 10 Electrical multimeters
- 2 simulators
- 5 Oscilloscope
- 5 Toolbox sets
- 5 Calibrating instruments
- 5 Automatic control circuits
- 5 PID control experiment circuits and components
- 5 Electrohydraulic control system circuits
- 5 Electropneumatic control system circuits
- 20 Relays
- 20 Contacts
- 2 Control of electrical propulsion
- 2 Ship machinery automation.
- 5 Power management system controls
- 24 assorted PPE – hand gloves, dust coats, dust masks, helmets, ear muffs, industrial boots

Materials and supplies

- Assorted Stationery
- 6 assorted Cables
- 10 Computers
- 24 assorted Drawing instruments
  - Assorted Audio-visual materials

Reference materials

- 5 IEE regulations
- 5 MARPOL, SOLAS and other essential regulations and conventions
- 5 Working principles of shipboard communication systems
- 5 Occupational safety and health act (OSHA)
- 5 Work injury benefits act (WIBA)
- 5 Manufacturers' catalogues
- 5 KEBS standards

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
• Training Workshops and Laboratories (1)	• 24 Multimeter • 6 Electric motors • 24 Testers • 24 Circuit breakers • 6 Manufacturers' Manuals • Assorted	Motor Starters with starter circuit diagram
• 12 Desktop computers/laptops	• Instrumentation: Sensors, gauges, and meters used to measure operational parameters such as temperature, pressure, speed, and fuel consumption (5 each)	• Flashcards
• Internet connection	• Personal Protective Equipment (PPE): Safety gear such as gloves, goggles, and ear protection for practical sessions involving machinery operation (24 each)	• Flip charts

• 1 Projector • 1 Printer		• 2 packets of assorted colors of whiteboard marker pens
• 1 Whiteboard		• Printing papers
• Report writing templates		• Technical Publications: Industry standards, manuals, and guidelines from organizations like the International Maritime Organization (IMO) and classification societies (2 each)
• Interactive Whiteboards (1)		• Textbooks and References (24 each)
• Simulator (1)		• Training manual (6)
• Electronic Circuit experiment equipment (1)		• Handout notes (24)
• High voltage simulator (1)		• Audio-visual materials
• Models of AC and DC generators (1)		
• Marine Switchboard		

GENERATORS, POWER DISTRIBUTION AND COMMUNICATION SYSTEM

UNIT CODE: 0714 551 18A
TVET CDACC UNIT CODE: MET/CU/ETE/CR /05/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Operate Generators, Power Distribution and Communication Systems

Duration of Unit: 240 hours

Unit Description
This unit covers competencies required to Operate Generators, Power Distribution and Communication Systems. This unit specifies the competencies required by an electro technical officer to synchronize, share load, and change over generators, operate coupling and breaking connection, operate high voltage installations, operate electrical propulsion system, operate shipboard communication systems and operate low voltage power distribution system.

Summary of Learning Outcomes

1. Synchronize, share load, and change over generators
2. Operate coupling and breaking connection
3. Operate high voltage installations
4. Operate electrical propulsion system
5. Operate shipboard communication systems.
6. Operate low voltage power distribution system.
7. Operate electrical generators
8. Operate electrical power distribution systems.

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Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Synchronize, share load, and change over generators	• Meaning of terms
	• Generator and Electrical switch board safeties
	• Principle of load sharing, synchronization and changeover of generators
	• Methods of parallelling generators
	  • Auto-synchro
	  • Synchroscope
	  • Lamp-bright method
	  • Lamp-dark method
	  • Sequence method
	• Parameters to monitor when synchronizing, changing-over generators
	  • Frequency
	  • Voltage
	  • Phase angle
	• Control systems for distribution of active and reactive power of generators
	• Meaning of power factor
	• Excitation systems of generators and explain rotating rectifiers
	• Parameters and limits of generator diesel engines
	• Methods of frequency and voltage stabilization of shaft generators
	• Principle of power management
	• Conditions for Automatic start of emergency generator and starting methods
	• Electrical energy balance
	• Change over procedures
		• Written tests
		• Oral questioning
		• Observation
		• Practical tests

Learning Outcome	Content	Suggested Assessment Methods
	• Recording of change-over and reporting of any abnormalities	
2. Operate coupling and breaking connection	• Meaning of terms • Electrical safety • Electrical energy generation and distribution on ships • Construction, equipment and service of main switchboard • Construction, equipment and service of emergency switchboard • Operating principle of main and emergency switchboards • Connection between main and emergency switchboards • explains procedures for restarting ship equipment, after power supply failure (black-out) on board • Change-over to shore-connection • Record and reporting of operation of coupling and breaking connections	• Observation • Oral questioning • Practical tests • Written tests

3. Operate high voltage installations	• Meaning of terms
	• High Voltage Electrical safety
	• Electrical devices used for high voltage installation
	• Principles of High Voltage
	• Types of High voltage circuit breakers
	  • Vacuum circuit breakers (VCB)
	  • Gas circuit breakers (SF6)
	• Electrical Permits to work for high voltage
	• Parameters to be monitored on high voltage installations
	  • Voltage
	  • Current
		• Oral questioning
		• Practical tests
		• Observation
		• Written tests

Learning Outcome	Content	Suggested Assessment Methods
	• Insulation levels • Response to alarms or abnormal conditions of high voltage installations • Isolating earthing down and shutting down high voltage installations • Recording and reporting maintenance on high voltage installations	

4. Operate Electrical propulsion system	• Meaning of terms
	• Electrical safety
	• Types of electrical propulsion system
	• Operating sequence of electrical propulsion system
	  • Starting
	  • Stopping
	  • Speed and direction changing
	• System parameters
	• Recording and reporting operation of electrical propulsion system
	  • Operational activities
	  • Performance data
		• Oral questioning
		• Practical tests
		• Observation
		• Written tests

5. Operate shipboard communications	• Meaning of terms • Types of shipboard communication • Safeties on shipboard communication • Operation of various shipboard communication • Troubleshooting • Regular checks and maintenance • Recording and reporting operation of shipboard communication	• Practical tests • Oral questioning • Observation • Written tests
6. Operate low voltage power distribution system.	• Meaning of terms • Electrical safety • Types of low voltage distribution systems	• Oral questioning • Practical tests • Observation • Written tests

Learning Outcome	Content	Suggested Assessment Methods

	• Transmission and distribution of electrical power
	• Components of low voltage distribution system
	• Electrical Loads
	  • Essential
	  • Non-essential
	• Types of faults on electrical power distribution system
	  • Trips
	  • overloads
	• protective devices
	• Structure of electrical switchboards
	• Energizing of low voltage electrical system
	• Operating parameters of low voltage electrical systems
	• Shut down procedures
	• Recording and reporting operation low voltage electrical systems	

7. Operate electrical generators	• Meaning of terms
	• Electrical safety
	• Types of Generators
	• Principles of operation of generators
	• Types of Generator protection
	• Operation procedures
	  • Starting procedures
	  • Parameters monitoring
	  • Shutdown procedures
	• Recording and reporting on operation of electrical generators
		• Oral questioning
		• Practical tests
		• Observation
		• Written tests

8. Operate electrical power distribution systems.	• Meaning of terms • Electrical safety • Types of electrical power distribution systems	• Oral questioning • Practical tests • Observation • Written tests

Learning Outcome	Content	Suggested Assessment Methods

	• Components of electrical power distribution system
	• Electrical Loads
	  • Essential
	  • Non-essential
	• Types of faults on electrical power distribution system
	  • Trips
	  • overloads
	• Energizing of electrical power distribution system
	• Operating parameters of electrical systems
	• Shut down procedures
	• Recording and reporting operation electrical power distribution systems	

Suggested Methods of Instruction

- Demonstration by trainer
- Practice by the trainee
- Field trips
- Discussions

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
Training Workshops and Laboratories (1)	• 24 Multimeter • 6 Electric motors • 24 Testers • 24 Circuit breakers • 6 Manufacturers' Manuals • Assorted • Insulation resistance tester	Motor Starters with starter circuit diagram
12 Desktop computers/laptops • 10 PLCs	• 4 Sensors and transducers	• Flashcards

• Programming software		
Internet connection	Personal Protective Equipment (PPE): Safety gear such as gloves, goggles, and ear protection for practical sessions involving machinery operation (24 each)	• Flip charts
• 2 Projector • 2 Printer		2 packets of assorted colors of whiteboard marker pens
2 Whiteboard		Printing papers
Report writing templates		Technical Publications: Industry standards, manuals, and guidelines from organizations like the International Maritime Organization (IMO) and classification societies (2 each)
Interactive Whiteboards (1)		Textbooks and References (24 each)
• Simulator (1) • Shipboard power management systems		Training manual (6)
Electronic Circuit experiment equipment (1)		Handout notes (24)
High voltage simulator (1)		Audio-visual materials
Models of AC and DC generators (1)		Manufacturers' manuals
Marine Switchboard		

AUTOMATION AND CONTROL SYSTEMS MAINTENANCE

UNIT CODE: 0714 551 19A
TVET CDACC UNIT CODE: MET/CU/ETE/CR /06/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Maintain automation and control systems

Duration of Unit: 100 hours

Unit Description
This unit specifies competencies required by an electro technical officer to maintain automation and control systems. It entails maintenance of fuel oil control systems, compressed air control system, lubrication oil control systems, cooling control systems, steam production control system, refrigeration plants control system, auxiliary engine control system, main propulsion engine control system, auxiliary machinery control system, steering gear control system, variable pitch propeller control system and the control system for air

Summary of Learning Outcomes

1. Maintain fuel oil control systems
2. Maintain compressed air control system
3. Maintain lubrication oil control systems
4. Maintain cooling control systems
5. Maintain steam production control system
6. Maintain refrigeration plants control system
7. Maintain auxiliary engine control system
8. Maintain main propulsion engine control system
9. Maintain auxiliary machinery control system
10. Maintain steering gear control system
11. Maintain variable pitch propeller control system
12. Maintain control system, for air conditioning

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Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Maintain fuel oil control systems	• Appropriate PPE • Fundamentals of Control • Control theory and Control Action • Proportional Integral Derivative (PID) Controller • Programmable Logic Controller (PLC) • Structure and principles of PLC • Programmable automatic controllers • Calibration • Controller Algorithm and Controller tuning • Final Control Element • Fail safe • Principles of industrial sequence control • Types of marine fuels • Properties of different types of marine fuels • Components of fuel systems • HFO Viscosity Control • Fuel Oil temperature control • Automatic control system for Fuel oil purifiers • Procedures for starting and stopping fuel oil purifiers • Safe isolation practice for maintenance of fuel oil control system • Types of maintenance and procedures e.g. • Periodic service	• Written tests • Oral questioning • Practical tests • Observation

	• Preventive • Breakdown • Maintenance checklist • Maintenance work plan • Scheduling maintenance based on service manuals/ PMS • Common maintenance tasks on fuel control systems	
2. Maintain compressed air control system	• Appropriate PPE • Safety practices • Interpretation of PLC/PID automatic control system of control air system • Description of • Safe isolation of compressed air control system • Maintenance checklist • Maintenance work plan • Types of maintenance and procedures e.g. • Periodic service • Preventive • Breakdown • Scheduling maintenance based on service manuals/PMS • Reporting procedures	• Observation • Oral questioning • Written tests
3. Maintain lubrication oil control systems	• Appropriate PPE • Safety practices • Interpretation of PLC/PID automatic control system of control air system • Description of lubrication oil controls • Safe isolation of LO system controls	• Observation • Oral questioning • Practical tests • Written tests

	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  • Periodic service
	  • Preventive
	  • Breakdown
	• Scheduling maintenance based on service manuals/PMS
	• Reporting procedures
	• Types of marine lube oils (LO)
	• Properties of different types of marine LO
	• Components of LO systems
	• LO temperature control
	• Automatic control system for LO purifiers
	• Procedures for starting and stopping LO purifiers	

4. Maintain cooling control systems	• Appropriate PPE
	• Safety practices
	• Interpretation of PLC/PID automatic control system of control air system
	• Description of cooling controls
	• Safe isolation of cooling system controls
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  • Periodic service
	  • Preventive
	  • Breakdown
	• Scheduling maintenance based on service manuals/PMS
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

	• Reporting procedures	

5. Maintain steam production control system	• Appropriate PPE
	• Safety practices in steam production
	• Interpretation of PLC/PID automatic control system of control air system
	• Description of the construction and operation of steam boilers
	• Description of automatic control systems for auxiliary boilers
	• Description of automatic steam production control
	• Water Level control
	• Combustion control
	• Burner management
	• Fuel viscosity control (Heavy Fuel oil only)
	• Superheated steam temperature control (normally on main boilers)
	• Safe isolation of steam production control
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  • Periodic service
	  • Preventive
	  • Breakdown
	• Scheduling maintenance based on service manuals/PMS
	• Reporting procedures
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

6. Maintain refrigeration plants control system	• Description of automatic control systems of provision and cargo refrigeration plant
	• Starting and stopping procedures for automatic control systems of provision and cargo refrigeration plant
	• Safe isolation of plant
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  • Periodic service
	  • Preventive
	  • Breakdown
	• Scheduling maintenance based on service/PMS Maintenance report writing
	  • Procedure of writing maintenance report
	  • Components of maintenance report
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

7. Maintain auxiliary engine control system	• Functions and tasks of control systems
	• Description of automatic control systems of auxiliary engine control system
	• Starting and stopping procedures for automatic control systems of auxiliary engine control system
	• Safe isolation of auxiliary engine
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  • Periodic service
	  • Preventive
	  • Breakdown
	• Scheduling maintenance based on service/PMS
		•

	• Maintenance report writing
	  • Procedure of writing maintenance report
	  • Components of maintenance report	

8. Maintain main propulsion engine control system	• Functions and tasks of control systems
	• Block diagram of main propulsion control systems
	• Main propulsion and emergency propulsion control
	• Principle of propulsion control changeover in emergency (use of engine telegraph)
	• Safety system of main propulsion (the blockade of the start, shutdown and slowdown)
	• Electronic and electrical control systems operating parameters of the main propulsion
	• Speed control and reversing systems of main engine
	• Procedures for:
	  • Preparations to start main engine
	  • Clutching main engine
	  • Change over main engine control
	  • Stopping and preparing main engine to harbor condition
	• Starting and stopping procedures for automatic control systems of main propulsion engine control system
	• Safe isolation of main propulsion engine control system
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

	• Periodic service
	• Preventive
	• Breakdown
	• Scheduling maintenance based on service/PMS
	• Maintenance report writing
	  • Procedure of writing maintenance report
	  • Components of maintenance report	

9. Maintain auxiliary machinery control system	• Description of auxiliary machinery control system
	• Procedures for preparation and starting air compressors
	• Automation of Auxiliary machinery
	• Procedures for use of auxiliary machinery
	• Safe isolation of auxiliary machinery control system
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  • Periodic service
	  • Preventive
	  • Breakdown
	• Scheduling maintenance based on service/PMS
	• Maintenance report writing
	  • Procedure of writing maintenance report
	  • Components of maintenance report
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

10. Maintain steering gear control system	• Description of automatic control systems for steering gear
	• Safe isolation of steering gear control system
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  • Periodic service
	  • Preventive
	  • Breakdown
	• Scheduling maintenance based on service/PMS
	• Maintenance report writing
	  • Procedure of writing maintenance report
	  • Components of maintenance report
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

11. Maintain variable pitch propeller control system.	• Description of variable pitch propeller
	• Speed control and reversing systems of variable pitch propeller
	• Safe isolation of variable pitch propeller
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  • Periodic service
	  • Preventive
	  • Breakdown
	• Scheduling maintenance based on service/PMS
	• Maintenance report writing
	  • Procedure of writing maintenance report
	  • Components of maintenance report
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

12. Maintain control system for air conditioning	• Description of automatic control systems of air conditioning plant
	• Starting and stopping procedures for automatic control systems of air conditioning
	• Safe isolation of variable pitch propeller
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  • Periodic service
	  • Preventive
	  • Breakdown
	• Scheduling maintenance based on service/PMS
	• Maintenance report writing
	  • Procedure of writing maintenance report
	  • Components of maintenance report
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

Suggested Methods of Instruction

- Demonstration by trainer
- Practice by the trainee
- Sea service training
- On-job-training
- Discussions

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
• Training Workshops and Laboratories (1) • Electric equipment testing 1	• 2 Hand tools each • 1 Machine tools each • 24 Multimeter • 6 Electric motors • 24 Testers • 24 Circuit breakers • 6 Manufacturers' Manuals • 24 Switches • 24 Circuit breakers	

	• 24 Push buttons • 24 Control lamps • 24 Fuses • 12 Lighting fixtures • 1 Soldering	
• 12 Desktop computers/laptops	• Instrumentation: Sensors, gauges, and meters used to measure operational parameters such as temperature, pressure, speed, and fuel consumption (5 each)	• A.C. and D.C. electrical machines
• Internet connection	• Personal Protective Equipment (PPE): Safety gear such as gloves, goggles, and ear protection for practical sessions involving machinery operation (24 each)	• Flip charts
• 1 Projector • 1 Printer		• 2 packets of assorted colors of whiteboard marker pens
• 1 Whiteboard		• Printing papers
• Report writing templates	• Lock-out-tag-out kit • L5 ead-acid and alkaline batteries, a charging circuit, distilled water, hydrometer • 5 Tank Scope, Multi-gas Detector-calibration and Span Gas • 5 Limit switches and overload trips	• Technical Publications: Industry standards, manuals, and guidelines from organizations like the International Maritime Organization (IMO) and classification societies (2 each)
• Interactive Whiteboards (1)		• Textbooks and References (1 each)

• Simulator (1)		• Training manual (6)
• 2 Engine room simulator		• Handout notes (24)
• 2 Cargo handling systems simulator		• Audio-visual materials
• PID control systems or adequate simulator		
• Oil discharge monitoring equipment		

BRIDGE NAVIGATION AND COMMUNICATION EQUIPMENT MAINTENACE

UNIT CODE: 0714 551 20A
TVET CDACC UNIT CODE: MET/CU/ETE/CR /07/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Maintain bridge navigation and communication equipment

Duration of Unit: 60 hours

Unit Description
This unit covers competencies required to perform maintenance on bridge navigation and communication. It entails maintenance of; ship's radar, global navigation satellite systems, ship compass equipment, speed logs, echo sounder systems, marine autopilots, voyage data recorders, shipboard communication systems and bridge navigation equipment

Summary of Learning Outcomes

1. Maintain ship's radar
2. Maintain global navigation satellite systems
3. Maintain ship compass equipment,
4. Maintain speed logs
5. Maintain echo sounder systems
6. Maintain marine autopilots
7. Maintain voyage data recorders
8. Maintain shipboard communication systems
9. Maintain bridge navigation equipment

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Maintain ship's radar	• Basic navigation principles • Define navigation • Describe basic navigational terms and their measuring units: latitude, longitude, position,	• Written tests • Oral questioning • Practical tests • Observation

	speed, distance, bearing, heading, waypoint, track, cross track error • describes the principle of navigation charts, basic information they contain and their various types: paper charts, electronic charts (Raster, ECDIS) • names and describes various types of navigation: terrestrial (Dead Reckoning), celestial, radar, radio, satellite, inertial • Describe radar principle of operation • Names main components of radars and their location onboard, describes their function • Draw up block diagram showing configuration of bridge radar system with interswitch • Explain how to find and use radar diagnostic functions and troubleshooting documentation • Explain how radar performance monitor works • Describe how to change magnetron assembly and tune the radar in after the repair • Explain the definition, principle and terminology used in Automatic Radar Plotting Aids (ARPA) Meaning of term • Correct isolation and safety procedure • Describes periodic maintenance jobs for radar system • Maintenance checklist • Maintenance work plan • Types of maintenance and procedures e.g. o Periodic service o Preventive o Breakdown • Scheduling maintenance based on service manuals • Maintenance report writing o Procedure of writing maintenance report o Components of maintenance report	

2. Maintain global navigation satellite systems	• basic knowledge of operation, maintenance and troubleshooting of Global Navigation Satellite Systems:
	  ○ Principle of operation of Global Navigation
	  ○ Satellite Systems: GPS, GLONASS, Galileo
	  ○ Main components of GPS system on board and their functions
	  ○ Operation of DGPS as compared to GPS
	  ○ How to GPS receiver is interfaced with other navigation equipment?
	  ○ How to test GPS output signals?
	• Correct isolation and safety procedure
	• Describes periodic maintenance jobs for global navigation satellite systems.
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  ○ Periodic service
	  ○ Preventive
	  ○ Breakdown
	• Scheduling maintenance based on service manuals
	• Maintenance report writing
	  ○ Procedure of writing maintenance report
	  ○ Components of maintenance report
		• Observation
		• Oral questioning
		• Written tests

3. Maintain ship compass equipment	• Basic knowledge of operation, maintenance and repairs of ship compass equipment: • Principle of operation and main components of gyro compass with spinning gyroscope • Synchronization process and deviations of gyrocompass • Principle of operation and main components of Fiber Optic Gyrocompass (FOG) and Ring Laser Gyroscope (RLG) • How gyrocompass is interfaced to other navigation equipment on the bridge	• Observation • Oral questioning • Practical tests • Written tests

	• Principle of operation and main components of magnetic compass with remote repeater system
	• Description of periodic maintenance work required for gyrocompass with spinning gyroscope and other moving parts
	• Correct isolation and safety procedure
	• Describes periodic maintenance jobs for global navigation satellite systems.
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  ○ Periodic service
	  ○ Preventive
	  ○ Breakdown
	• Scheduling maintenance based on service manuals
	• Maintenance report writing
	  ○ Procedure of writing maintenance report
	  ○ Components of maintenance report	

4. Maintain speed logs	• Basic knowledge of construction, operation, maintenance and troubleshooting of various speed logs:
	  ○ Doppler Log System
	  ○ Electromagnetic Log System
	  ○ Pitometer Log System
	• Correct isolation and safety procedure
	• Describes periodic maintenance jobs for Speed logs
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  ○ Periodic service
	  ○ Preventive
	  ○ Breakdown
	• Scheduling maintenance based on service manuals
	• Maintenance report writing
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

	○ Procedure of writing maintenance report ○ Components of maintenance report	
5. Maintain echo sounder systems	• basic knowledge of construction, operation, configuration, maintenance and troubleshooting of echo sounder system. • Correct isolation and safety procedure • Describes periodic maintenance jobs for Echo Sounder • Maintenance checklist • Maintenance work plan • Types of maintenance and procedures e.g. ○ Periodic service ○ Preventive ○ Breakdown • Scheduling maintenance based on service manuals • Maintenance report writing ○ Procedure of writing maintenance report ○ Components of maintenance report	• Observation • Oral questioning • Practical tests • Written tests
6. Maintain marine autopilots	• Principle of operation of marine autopilots • Modes of operation • Example of modern autopilot and its features • Describes periodic maintenance jobs for marine autopilots • Correct isolation and safety procedure • Maintenance checklist • Maintenance work plan • Types of maintenance and procedures e.g. ○ Periodic service ○ Preventive ○ Breakdown • Scheduling maintenance based on service manuals • Maintenance report writing ○ Procedure of writing maintenance report ○ Components of maintenance report	• Observation • Oral questioning • Practical tests • Written tests

7. Maintain voyage data recorders	• Basic knowledge of operation and periodic maintenance of Voyage Data Recorder
	• Basic knowledge of operation, maintenance and repair of Navigation Lights Control and Alarm System
	• Basic knowledge of operation, maintenance and troubleshooting of Search Lights and its Remote Control System
	• Basic knowledge of operation, maintenance and repair of ship Horns and Sound Signal Control System
	• Basic knowledge of operation, configuration, maintenance and troubleshooting of wind tracker and its relative and true wind repeaters
	• Describes periodic maintenance jobs voyage data recorders
	• Correct isolation and safety procedure
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  o Periodic service
	  o Preventive
	  o Breakdown
	• Scheduling maintenance based on service manuals
	• Maintenance report writing
	  o Procedure of writing maintenance report
	  o Components of maintenance report
		• Written tests
		• Oral questioning
		• Practical tests
		• Observation

8. Maintain shipboard communication systems	• Basic knowledge of frequency ranges used in marine communication and electromagnetic waves propagation for various frequencies • Block diagram showing main components of receiving and transmitting lines of radio communication equipment • Various antenna types used in marine communication and their maintenance	• Written tests • Oral questioning • Practical tests • Observation

	• Description of disturbances which can affect operation of ship communication systems
	• Meaning of GMDSS, describes its purpose and structure
	• Components of GMDSS and brief description of their purpose, operation and maintenance: Inmarsat Sat C, NBDB telex terminal with MF/HF transceiver, DSC, NAVTEX, EPIRB, SART
	• Description of main and emergency power supply of ship
	• Communication systems, their maintenance and testing
	• Structure, range, operation and maintenance of Inmarsat Satellite Communication System
	• Structure, range, operation and maintenance of Iridium Satellite Telephone System
	• Structure, range, operation, testing and maintenance of Automatic Identification System (AIS)
	• Structure, range, operation, testing and maintenance of Long Range Identification and Tracking System (LRIT)
	• Structure, operation, testing and maintenance of Ship Security Alert System (SSAS)
	• Describes periodic maintenance jobs of ship's communication system
	• Correct isolation and safety procedure
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  o Periodic service
	  o Preventive
	  o Breakdown
	• Scheduling maintenance based on service manuals
	• Maintenance report writing	

	○ Procedure of writing maintenance report ○ Components of maintenance report	
9. Maintain bridge navigation equipment	• Basic knowledge of operation of inertial navigation system • Basic knowledge of operation, maintenance and repair of Navigation Lights Control and Alarm System • Basic knowledge of operation, maintenance and troubleshooting of Search Lights and its Remote Control System • Basic knowledge of operation, maintenance and repair of ship Horns and Sound Signal Control System • Basic knowledge of operation, configuration, maintenance and troubleshooting of wind tracker and its relative and true wind repeaters • Describes periodic maintenance jobs navigation lights, Search lights, ships horns and sound signals systems • Describes periodic maintenance jobs of ship's navigation equipment • Correct isolation and safety procedure • Maintenance checklist • Maintenance work plan • Types of maintenance and procedures e.g. ○ Periodic service ○ Preventive ○ Breakdown • Scheduling maintenance based on service manuals • Maintenance report writing ○ Procedure of writing maintenance report ○ Components of maintenance report	• Written tests • Oral questioning • Practical tests Observation

Suggested Methods of Instruction

- Demonstration by trainer

- Practice by the trainee
- Field trips
- On-job-training
- Discussions

Recommended Resources for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
Training Workshops and Laboratories (1)	• 6 Set of screw drivers • 6 Set of spanners and wrenches • 6 Power tools • 6 Cutting tools • 24 Pliers • 6 Lifting and tensioning tools • 6 Tool box • 24 Phase tester • 24 Clamp meter • 5 Earth electrode resistance meter • 24 Phase sequence meter • 24 Multimeter • 3 Compass •	Equipment manufacturer manuals Navigation aids
12 Desktop computers/laptops	• 6 Automatic control system • 6 Transducers • 6 PID controllers • 6 PLC controllers • 6 Level PID controllers. • 6 Flow PID controllers. • 24 Relays • 24 Contacts	• Flashcards
Internet connection	24 Sets of Personal Protective Equipment (PPE): Safety gear such as gloves, goggles, and ear	• Flip charts

	protection for practical sessions involving machinery operation (24 each)	
• 2 Projector • 2 Printer		2 packets of assorted colors of whiteboard marker pens
2 Whiteboard		Printing papers
Report writing templates		Technical Publications: Industry standards, manuals, and guidelines from organizations like the International Maritime Organization (IMO) and classification societies (2 each)
Interactive Whiteboards (1)		Textbooks and References (24 each)
• 5 Bridge simulator • automatic telephone system		Training manual (6)
2 Model of bridge equipment's		Handout notes (24)
bridge navigation and ship communication systems		Audio-visual materials
Electro-hydraulic and electro-pneumatic systems		

DECK MACHINERY ELECTRICAL, ELECTRONIC AND CONTROL SYSTEM MAINTENANCE

UNIT CODE: 0714 551 21A
TVET CDACC UNIT CODE: MET/CU/ETE/CR /08/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Maintain electrical, electronic and control system for deck machinery.

Duration of Unit: 60 hours

Unit Description
This unit covers competencies required to perform maintenance of electrical, electronic and control system for deck machinery. It entails maintaining mooring and windlass electrical, electronic control system, maintaining deck cranes electrical, electronic and control system, maintaining reefers containers electrical, electronic and control system, maintaining liquid and gas cargo systems electrical, electronic and control system, maintaining accommodation ladder electrical, electronic control system, maintaining hatch cover winches electrical, electronic control system and maintaining lifeboat winches electrical, electronic control system

Summary of Learning Outcomes

1. Maintain mooring winch and windlass electrical, electronic control system,
2. Maintain deck cranes electrical, electronic and control system
3. Maintain reefers containers electrical, electronic and control system
4. Maintain liquid and gas cargo systems electrical, electronic and control system
5. Maintain accommodation ladder electrical, electronic control system
6. Maintain hatch cover winches electrical, electronic control system
7. Maintain lifeboat winches electrical, electronic control system

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Maintain mooring winch and windlass	• Principle of operation and names main components of electrical, electronic and control	• Written tests • Oral questioning

electrical, electronic control system	systems of deck machinery, with specific reference to: o mooring winches with manual and automatic control o windlasses with manual and automatic control • Principles of routine inspection, maintenance and repair of deck machinery equipment, with specific reference to: o Power supply o Cabling and grounding o Switchboards, terminal strips, connectors o Control panels o PLC outputs and inputs o Electrical motors and brakes o Power electronic converters o Limit switches o Safety devices o Electric control of hydraulic pumps, motors, valves and brakes o Ventilation, heating • Meaning of term • Maintenance checklist • Maintenance work plan • Identification of maintenance personnel • Types of maintenance and procedures e.g. • Periodic service • Preventive • Breakdown • Scheduling maintenance based on service manuals • Correct isolation and safety procedure • Maintenance checklist • Maintenance work plan • Types of maintenance and procedures e.g. o Periodic service o Preventive o Breakdown	• Practical tests • Observation

	• Scheduling maintenance based on service manuals
	• Maintenance report writing
	  ○ Procedure of writing maintenance report
	  ○ Components of maintenance report	

2. Maintain deck cranes electrical, electronic and control system	• principle of operation and names main components of electrical, electronic and control systems of deck cranes, with specific reference to:
	  ○ Single deck cranes
	  ○ Double deck cranes
	  ○ Gantry cranes
	• principles of routine inspection, maintenance and repair of deck cranes equipment, with specific reference to:
	  ○ Power supply (slip ring unit)
	  ○ Cabling and grounding
	  ○ Switchboards, terminal strips, connectors
	  ○ Control panels
	  ○ Portable controllers
	  ○ Plc outputs and inputs
	  ○ Electrical motors and brakes
	  ○ Power electronic converters
	  ○ Limit switches
	  ○ Safety devices
	  ○ Electric control of hydraulic pumps, motors and brakes
	  ○ Electric control of grabs, container spreaders and other cargo lifting facilities
	  ○ Ventilation, heating
	• Correct isolation and safety procedure
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  ○ Periodic service
	  ○ Preventive
	  ○ Breakdown
		• Observation
		• Oral questioning
		• Written tests

	• Scheduling maintenance based on service manuals
	• Maintenance report writing
	  ○ Procedure of writing maintenance report
	  ○ Components of maintenance report	

3. Maintain reefers containers electrical, electronic and control system	• Principles of routine inspection, maintenance and repair of reefer containers
	• Correct isolation and safety procedure
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  ○ Periodic service
	  ○ Preventive
	  ○ Breakdown
	• Scheduling maintenance based on service manuals
	• Calibrations of reefers
	• Components of reefers
	• Maintenance report writing
	  ○ Procedure of writing maintenance report
	  ○ Components of maintenance report
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

4. Maintain liquid/gas cargo systems electrical, electronic and control system	• Principle of operation and names main components of electrical, electronic and control systems of cargo systems on tankers, with specific reference to:
	  ○ Cargo pumps with turbine, electric and hydraulic drive
	  ○ Ballast pumps
	  ○ Inert gas system
	  ○ Cargo and ballast tanks level measuring and alarm systems
	  ○ Cargo and ballast valves
	
	• Principles of routine inspection, maintenance and repair of cargo systems on tankers, with specific reference to:
	  ○ Power supply
	  ○ Cabling and grounding
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

	○ Switchboards, terminal strips, connectors ○ Control panels ○ Plc outputs and inputs ○ Safety devices ○ Electric motors ○ Power electronic converters ○ Electric control of hydraulic pumps and motors ○ Electric control of steam turbines ○ Electric control system of cargo and ballast valves ○ Ventilation and heating ○ Tank level measurement sensors and systems • Parameters of flammable substances as: ○ LEL, UEL ○ Temperature class ○ Split on groups and subgroups • Split hazardous area on zones or divisions • Explosion-proof type of protection of electrical equipment for gas-explosive area: ○ Flameproof enclosures "d" ○ Pressurized enclosures "px, py, pz" ○ Powder filling "q" ○ Oil immersion "o" ○ Increased safety "e" ○ Intrinsic safety "ia, ib, ic" ○ Non-incendive "na, nc, nl, nr, np" ○ Encapsulation "ma, mb, mc" ○ Optical radiation "op is, op pr, op sh" • Explosion-proof type of protection of electrical equipment for dust-explosive area • Lists of types of protection of non-electrical equipment • Rules of cabling running in hazardous area • Marking of explosion proof equipment • Principles of maintenance of electrical explosion-proof equipment	

	• Meaning of iecex, ATEX and North America approach
	• Meaning of Ex certificate
	
	• Correct isolation and safety procedure
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  o Periodic service
	  o Preventive
	  o Breakdown
	• Scheduling maintenance based on service manuals
	• Maintenance report writing
	  o Procedure of writing maintenance report
	  o Components of maintenance report	

5. Maintain accommodation ladder electrical, electronic control system	• principle of operation and names main components of electrical, electronic and control systems of deck machinery, with specific reference to accommodation ladder winches
	
	• Correct isolation and safety procedure
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  o Periodic service
	  o Preventive
	  o Breakdown
	• Scheduling maintenance based on service manuals
	• Maintenance report writing
	  o Procedure of writing maintenance report
	  o Components of maintenance report
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

6. Maintain hatch cover winches electrical, electronic control system	• principle of operation and names main components of electrical, electronic and control systems of deck machinery, with specific reference to hatch covers winches
	
	• Correct isolation and safety procedure
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  o Periodic service
	  o Preventive
	  o Breakdown
	• Scheduling maintenance based on service manuals
	• Maintenance report writing
	  o Procedure of writing maintenance report
	  o Components of maintenance report
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

7. Maintain lifeboat winches electrical, electronic control system	• principle of operation and names main components of electrical, electronic and control systems of deck machinery, with specific reference to lifesaving boat winches
	
	• Correct isolation and safety procedure
	• Maintenance checklist
	• Maintenance work plan
	• Types of maintenance and procedures e.g.
	  o Periodic service
	  o Preventive
	  o Breakdown
	• Scheduling maintenance based on service manuals
	• Maintenance report writing
	  o Procedure of writing maintenance report
	  o Components of maintenance report
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

Suggested Methods of Instruction

- Demonstration by trainer
- Practice by the trainee
- Field trips
- On-job-training
- Discussions

Reference materials for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
Training Workshops and Laboratories (1)	• 24 Set of screw drivers • 5 Set of spanners and wrenches • 5 Power tools • 24 Cutting tools • 24 Pliers • 24 Lifting and tensioning tools • 6 Tool box • 5 Phase tester • 6 motors • 12 contactors	• Electrohydraulic control system circuits • 2 Electropneumatic control system circuits • Automatic control circuits
12 Desktop computers/laptops	• 6 Automatic control system • 6 Transducers • 6 PID controllers • 6 PLC controllers • 6 Level PID controllers. • 6 Flow PID controllers. • 24 Relays • 24 Contacts •	Assorted Flashcards
Internet connection	• Personal Protective Equipment (PPE): Safety gear such as gloves, goggles, and ear protection for practical sessions involving machinery operation (24 each)	Flip charts

• 2 Projector • 2 Printer		• 2 packets of assorted colors of whiteboard marker pens
• 2 Whiteboards		• Printing papers
• Report writing templates		• Technical Publications: Industry standards, manuals, and guidelines from organizations like the International Maritime Organization (IMO) and classification societies (2 each)
• Interactive Whiteboards (1)		• Textbooks and References (24 each)
• cargo handling systems simulators (1)		• Training manual (6)
• PLC control and monitoring systems (1)		• Handout notes (24)
• L.V. main switchboard (1)		• Audio-visual materials
• PID control systems or adequate simulator (1)		

HOTEL EQUIPMENT CONTROL AND SAFETY SYSTEMS MAINTENANCE

UNIT CODE: 0714 551 22A
TVET CDACC UNIT CODE: MET/CU/ETE/CR /9/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Maintain control and safety systems of hotel equipment

Duration of Unit: 30 hours

Unit Description
This unit specifies competencies required by an electro-technician to maintain control and safety systems of hotel equipment. It involves the maintenance of control and safety systems of ship elevators, galley equipment, laundry equipment, hotel alarm systems, hotel lighting systems and hotel safety systems.

Summary of Learning Outcomes

1. Maintain control and safety systems of ship elevators
2. Maintain control and safety systems of galley equipment
3. Maintain control and safety systems of laundry equipment
4. Maintain control and safety systems of hotel alarm systems
5. Maintain control and safety systems of hotel lighting system
6. Maintain control and safety systems of hotel safety systems

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Maintain control and safety systems of ship elevators	• Meaning of terms • Electrical and elevator safety • Fundamentals of Control • Control theory and Control Action • Proportional Integral Derivative (PID) Controller	• Written tests • Oral questioning • Practical tests • Observation

	• Programmable Logic Controller (PLC) • Structure and principles of PLC • Programmable automatic controllers • Calibration • Controller Algorithm and Controller tuning • Final Control Element • Fail safe • Principles of industrial sequence control • Construction of elevators • Principles of operation of elevators • Types of elevator safeties protections • Permits to work • Isolation of elevators • Types of faults on elevators • Maintenance procedures of elevators • Use of elevator diagnostic system for troubleshooting and repairs • Operate, test and repair elevator trap alarm or intercom • Recording and reporting maintenance on elevators	
2. Maintain control and safety systems of galley equipment	• Meaning of terms • Electrical safety • Fundamentals of Control systems • Types of galley equipment • Power supply circuits for galley equipment and environmental conditions this equipment is subjected to • Working principles of galley equipment • Isolation of galley equipment • Types of faults on galley equipment • Maintenance and repair of galley equipment • Recording and reporting maintenance on galley equipment	• Observation • Oral questioning • Written tests

3. Maintain control and safety systems of laundry equipment	• Meaning of terms • Electrical safety • Fundamentals of Control systems • Types of laundry equipment • Working principles of laundry equipment • Isolation of laundry equipment • Types of faults on laundry equipment • Maintenance and repair of laundry equipment • Recording and reporting maintenance on laundry equipment	• Observation • Oral questioning • Practical tests • Written tests
4. Maintain control and safety systems of hotel alarm systems	• Meaning of terms • Electrical safety • Fundamentals of Control systems • Structure and operation of advanced fire detection and control system installed • Maintenance, diagnostics and repairs of advanced fire detection and control system • Maintenance, diagnostics and repairs of hospital call system • Maintenance, diagnostics and repairs of cold room trap alarms • Recording and reporting maintenance on hotel alarm systems	• Observation • Oral questioning • Practical tests • Written tests
5. Maintain control and safety systems of hotel lighting system	• Meaning of terms • Electrical safety • Fundamentals of Control systems • Structure of advanced lighting systems • Working principles of remote control of advanced hotel lighting systems • Isolation of hotel lighting systems • Main features of various hotel lighting systems • Maintenance of hotel lighting systems • Recording and reporting maintenance on hotel lighting systems	• Observation • Oral questioning • Practical tests • Written tests
6. Maintain control and safety systems of hotel safety systems	• Smoke extraction systems • Screening detectors • Safety test of security equipment's	• Observation • Oral questioning • Practical tests

	• Maintenance of electrical door locks • Record keepings	• Written tests

Suggested Methods of Instruction

- Demonstration by trainer
- Practice by the trainee
- Field trips
- On-job-training
- Discussions

Reference materials for 24 trainees

General Resources	Tools and Equipment	Materials and Supplies
• Training Workshops and Laboratories (1)	• 2 Phones • 2 Cameras • 6 Manufacturers' Manuals • 6 Toolbox set • 24 Multimeters • 24 Testers • 24 Transformers • 1 Elevators	
• 12 Desktop computers/laptops	•	• Flashcards
• Internet connection	• Personal Protective Equipment (PPE): Safety gear such as gloves, goggles, and ear protection for practical sessions involving machinery operation (24 each)	• Flip charts
• 1 Projector • 1 Printer		• 2 packets of assorted colors of whiteboard marker pens
• 1 Whiteboard		• Printing papers

• Report writing templates		• Technical Publications: Industry standards, manuals, and guidelines from organizations like the International Maritime Organization (IMO) and classification societies (2 each)
• Interactive Whiteboards (1)		• Textbooks and References (24 each)
• Shipboard Hotel Equipment Simulator (1)		• Training manual (6)
• Galley, Food preparation and refrigeration equipment (1)		• Handout notes (24)
• L.V. main switchboard (1)		• Audio-visual materials
• Alarm and lighting systems (1)		
• Scullery and potwash equipment (1)		