

**REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**MARINE ENGINEERING TECHNICIAN**

**(SHIP CONSTRUCTION)**

**LEVEL 6**



TVET CDACC

P.O. BOX 15745-00100

NAIROBI

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# FOREWORD

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

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted to the formulation of the Policy Framework for Reforming Education and Training. A key feature of this policy is the radical change in the design and delivery of the TVET training. This policy document requires that training in TVET be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that these Occupational Standards were developed for the purpose of developing a competency-based curriculum for a Marine Engineering Technician Level 6 (Ship Construction). These Occupational Standards will also be the bases for assessment of an individual for competence certification.

It is my conviction that these Occupational Standards will play a great role towards development of competent human resource for the marine engineering sector’s growth and sustainable development.

**PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING**

**MINISTRY OF EDUCATION**

# PREFACE

Kenya Vision 2030 aims to transform the country into a newly industrializing, “middle-income country providing a high-quality life to all its citizens by the year 2030”. Kenya intends to create a globally competitive and adaptive human resource base to meet the requirements of a rapidly industrializing economy through life-long education and training. TVET has a responsibility of facilitating the process of inculcating knowledge, skills and attitudes necessary for catapulting the nation to a globally competitive country, hence the paradigm shift to embrace Competency Based Education and Training (CBET).

The Technical and Vocational Education and Training Act No. 29 of 2013 on Reforming Education and Training in Kenya, emphasized the need to reform curriculum development, assessment and certification. This called for a shift to CBET in order to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labour force.

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Marine Sector Skills Advisory Committee (SSAC) have developed these Occupational Standards for a Marine Engineering Technician (Ship Construction). These standards will be the basis for development of a competency-based curriculum for Marine Engineering (Ship Construction) Level 6. These Standards will also be the bases for assessment of an individual for competence certification.

The occupational standards are designed and organized with clear performance criteria for each element of a unit of competency. These standards also outline the required knowledge and skills as well as evidence guide.

I am grateful to the Council Members, Council Secretariat, Marine SSAC, expert workers and all those who participated in the development of these National Occupational standards.

**CHAIRPERSON, TVET CDACC**

# ACKNOWLEDGMENT

These Occupational Standards were developed through combined effort of various stakeholders from private and public organizations. I am sincerely thankful to the management of these organizations for allowing their staff to participate in this course. I wish to acknowledge the invaluable contribution of industry players who provided inputs towards the development of these Standards.

I thank TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) for providing guidance on the development of these Standards. My gratitude goes to the Marine Sector Skills Advisory Committee (SSAC) members for their contribution to the development of these Standards. I thank all the individuals and organizations who participated in the validation of these Standards.

I acknowledge all other institutions which in one way or another contributed to the development of these Occupational Standards.

**CHAIRPERSON**

**MARINE SECTOR SKILLS ADVISORY COMMITTEE**

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# A**CRONYMS**

CBET : Competency Based Education and Training

CDACC : Curriculum Development Assessment and Certification Council

OS : Occupational Standards

OSHA : Occupation Safety and Health Act

PPE ; Personal Protective Equipment

SSAC : Sector Skills Advisory Committee

ENG : Engineering

MAR : Marine

BC : Basic Competency

CC : Common Competency

CR : Core Competency

A : Control Version

KEY TO UNIT CODE

 ENG/OS /MAR/BC/ 01/ 6/A

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

Version Control

# OVERVIEW

Marine Engineering (Ship Construction) Level 6 qualification constis of competencies that a person must achieve to enable him/her to be certified as a Marine Engineer. The units of competency comprising Marine Engineering certificate level 6 qualifications include the following basic and core competencies:

**BASIC COMPETENCIES**

|  |  |
| --- | --- |
| **Unit of Competency Code** | **Unit of Competency Title** |
| ENG/OS/MAR/BC/01/6/A | Demonstrate communication skills |
| ENG/OS/MAR/BC/02/6/A | Demonstrate digital literacy |
| ENG/OS/MAR/BC/03/6/A | Demonstrate entrepreneurial skills |
| ENG/OS/MAR/BC/04/6/A | Demonstrate employability skills |
| ENG/OS/MAR/BC/05/6/A | Demonstrate environmental literacy |
| ENG/OS/MAR/BC/06/6/A | Demonstrate occupational health and safety practices |

**COMMON COMPETENCIES**

|  |  |
| --- | --- |
| **Unit of Competency Code** | **Unit of Competency Title** |
| ENG/OS/MAR/CC/01/6/A | Apply mechanical science principles |
| ENG/OS/MAR/CC/02/6/A | Apply fluid mechanics principles |
| ENG/OS/MAR/CC/03/6/A | Apply thermodynamics principles |
| ENG/OS/MAR/CC/04/6/A | Apply ship construction principles |
| ENG/OS/MAR/CC/05/6/A | Monitor and evaluate ship stability |
| ENG/OS/MAR/CC/06/6/A | Apply electrical principles |
| ENG/OS/MAR/CC/07/6/A | Apply ship electronics, controls and automation principles |
| ENG/OS/MAR/CC/08/6/A | Apply engineering mathematics  |
| ENG/OS/MAR/CC/09/6/A | Demonstrate basic sea survival skills |

**CORE COMPETENCIES**

|  |  |
| --- | --- |
| **Unit of Competency Code** | **Unit of Competency Title** |
| ENG/OS/MAR/CR/01/6/A | Survey hull and superstructure of a commercial vessel |
| ENG/OS/MAR/CR/02/6/A | Survey vessel operational systems |
| ENG/OS/MAR/CR/03/6/A | Prepare and interpret marine plant drawings |
| ENG/OS/MAR/CR/04/6/A | Install and maintain marine pumps |
| ENG/OS/MAR/CR/05/6/A | Install and maintain air compressors |
| ENG/OS/MAR/CR/06/6/A | Perform marine engine works |
| ENG/OS/MAR/CR/07/6/A | Operate marine electrical and electronic systems |
| ENG/OS/MAR/CR/08/6/A | Operate and maintain ship control and automation systems |
| ENG/OS/MAR/CR/09/6/A | Maintain marine transmission, shaft and propulsion system |
| ENG/OS/MAR/CR/10/6/A | Operate and maintain navigation and communication systems |
| ENG/OS/MAR/CR/11/6/A | Assess and monitor marine auxiliary systems |
| ENG/OS/MAR/CR/12/6/A | Manage marine organisation |

# BASIC COMPETENCIES

# DEMONSTRATE COMMUNICATION SKILLS

**UNIT CODE:** ENG/OS/MAR/BC/01/6/A

**UNIT DESCRIPTION**

This unit covers the competencies required to demonstrate communication skills. It involves meeting communication needs of clients and colleagues, developing communication strategies, establishing and maintaining communication pathways, conducting interviews, facilitating group discussion and representing the organization.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| 1. Meet communication needs of clients and colleagues
 | 1. Specific communication needs of clients and colleagues are identified and met based on workplace requirements
2. Different communication approaches are identified and applied according to clients’ needs
3. Conflict is identified and addressed as per the standards of the organization
 |
| 1. Develop communication strategies
 | * 1. Strategies for effective internal and external dissemination of information are developed as per organization’s requirements
	2. Special communication needs are considered in developing strategies according workplace procedures
	3. ***Communication strategies*** are analyzed, evaluated and revised based the workplace needs
 |
| 1. Establish and maintain communication pathways
 | * 1. Pathways of communication are established as per organization policy
	2. Pathways are maintained and reviewed according to organization procedures
 |
| 1. Promote use of communication strategies
 | * 1. Information is provided to all areas of the organization as per strategy requirements
	2. Effective communication techniques are articulated and modeled according work requirements
	3. Personnel are given guidance about adapting communication strategies as per organization procedures
 |
| 1. Conduct interview
 | 1. A range of appropriate communication strategies are employed in ***interview situations*** based on the workplace requirements
2. Records of interviews are made and maintained in accordance with organizational procedures
3. Effective questioning, listening and nonverbal communication techniques are used as per needs
 |
| 1. Facilitate group discussion
 | 1. Mechanisms to enhance ***effective group interaction*** are identified and implemented according to workplace requirements
2. Strategies to encourage group participation are identified and used as per organizations’ procedures
3. Meetings objectives and agenda are set and followed based on workplace requirements
4. Relevant information is provided and feedback obtained according to set protocols
5. Evaluation of group communication strategies is undertaken in accordance with workplace guidelines
6. Specific communication needs of individuals are identified and addressed as per individual needs
 |
| 1. Represent the organization
 | 1. 7Relevant presentation are researched and presented based on internal or external communication forums requirements
2. Presentation is delivered in a clear and sequential manner as per the predetermined time
3. Presentation is made as per appropriate media
4. Difference views are respected based on workplace procedures
5. Written communication is done as per organizational standards
6. Inquiries are responded according to organizational standard
 |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Communication strategies may include but not limited to:
 | * Language switch
* Comprehension check
* Repetition
* Asking confirmation
* Paraphrase
* Clarification request
* Translation
* Restructuring
* Approximation
* Generalization
 |
| 1. Effective group interaction may include but not limited to:
 | * Identifying and evaluating what is occurring within an interaction in a nonjudgmental way
* Using active listening
* Making decision about appropriate words, behavior
* Putting together response which is culturally appropriate
* Expressing an individual perspective
* Expressing own philosophy, ideology and background and exploring impact with relevance to communication
 |
| 1. Situations may include but not limited to:
 | * Establishing rapport
* Eliciting facts and information
* Facilitating resolution of issues
* Developing action plans
* Diffusing potentially difficult situations
 |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Active listening
* Interpretation
* Negotiation
* Writing

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Communication process
* Dynamics of groups
* Styles of group leadership
* Key elements of communications strategy

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency
 | Assessment requires evidence that the candidate: 1. Developed communication strategies to meet the organization requirements and applied in the workplace
2. Established and maintained communication pathways for effective communication in the workplace
3. Used communication strategies involving exchanges of complex oral information
 |
| 1. Resource Implications
 | The following resources should be provided: 1. Access to relevant workplace or appropriately simulated environment where assessment can take place
2. Materials relevant to the proposed activity or tasks
 |
| 1. Methods of Assessment
 | Competency in this unit may be assessed through: 1. Direct observation
2. Oral questioning
3. Written texts
 |
| 1. Context of Assessment
 | Competency may be assessed:1. On-the-job
2. Off-the –job
3. During Industrial attachment
 |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# DEMONSTRATE DIGITAL LITERACY

**UNIT CODE:** ENG/OS/MAR/BC/02/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to demonstrate digital literacy. It involves, identifying computer software and hardware, applying security measures to data, hardware, and software in automated environment, applying computer software in solving task, applying internet and email in communication at workplace, applying desktop publishing in official assignments and preparing presentation packages.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| 1. Identify appropriate computer software and hardware
 | * 1. Concepts of ICT are determined in accordance with computer equipment
	2. Classifications of computers are determined in accordance with manufacturers specification
	3. Appropriate computer software is identified according to manufacturer’s specification
	4. Appropriate computer hardware is identified according to manufacturer’s specification
	5. Functions and commands of operating system are determined in accordance with manufacturer’s specification
 |
| 1. Apply security measures to data, hardware, software in automated environment
 | * 1. ***Data security and privacy are classified*** in accordance with the prevailing technology
	2. ***Security threats*** reidentified ***and control measures*** are applied in accordance with laws governing protection of ICT
	3. Computer threats and crimes are detected in accordance to Information Management security guidelines
	4. Protection against computer crimes is undertaken in accordance with laws governing protection of ICT
 |
| 1. Apply computer software in solving tasks
 | * 1. ***Word processing concepts*** are applied in resolving workplace tasks, report writing and documentation as per the job requirements
	2. ***Word processing utilities*** are applied in accordance with workplace procedures
	3. Worksheet layout is prepared in accordance with work procedures
	4. Worksheet is built and data manipulated in the worksheet in accordance with workplace procedures
	5. Continuous data manipulated on worksheet is undertaken in accordance with work requirements
	6. Database design and manipulation is undertaken in accordance with office procedures
	7. Data sorting, indexing, storage, retrieval and security is provided in accordance with workplace procedures
 |
| 1. Apply internet and email in communication at workplace
 | * 1. Electronic mail addresses are opened and applied in workplace communication in accordance with office policy
	2. Office internet functions are defined and executed in accordance with office procedures
	3. ***Network configuration*** is determined in accordance with office operations procedures
	4. Official World Wide Web is installed and managed according to workplace procedures
 |
| 1. Apply Desktop publishing in official assignments
 | * 1. Desktop publishing functions and tools are identified in accordance with manufactures specifications
	2. Desktop publishing tools are developed in accordance with work requirements
	3. Desktop publishing tools are applied in accordance with workplace requirements
	4. Typeset work is enhanced in accordance with workplace standards
 |
| 1. Prepare presentation packages
 | * 1. Types of presentation packages are identified in accordance with office requirements
	2. Slides are created and formulated in accordance with workplace procedures
	3. Slides are edited and run-in accordance with work procedures
	4. Slides and handouts are printed according to work requirements
 |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Appropriate computer hardware may include but not limited to:
 | Collection of physical parts of a computer system such as:* Computer case, monitor, keyboard, and mouse
* All the parts inside the computer case, such as the hard disk drive, motherboard and video card
 |
| 1. Data security and privacy may include but not limited to:
 | * Confidentiality of data
* Cloud computing
* Integrity -but-curious data surfing
 |
| 1. Security and control measures may include but not limited to:
 | * Counter measures against cyber terrorism
* Risk reduction
* Cyber threat issues
* Risk management
* Pass-wording
 |
| 1. Security threats may include but not limited to:
 | * Cyber terrorism
* Hacking
 |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Analytical skills
* Interpretation
* Typing
* Communication
* Computing (applying fundamental operations such as addition, subtraction, division and multiplication)
* Using calculator
* Basic ICT skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Software concept
* Functions of computer software and hardware
* Data security and privacy
* Computer security threats and control measures
* Technology underlying cyber-attacks and networks
* Cyber terrorism
* Computer crimes
* Detection and protection of computer crimes
* Laws governing protection of ICT
* Word processing;
	+ - Functions and concepts of word processing.
		- Documents and tables creation and manipulations
		- Mail merging
		- Word processing utilities
* Spread sheets;
	+ - Meaning, formulae, function and charts, uses and layout
		- Data formulation, manipulation and application to cells
* Database;
	+ - Database design, data manipulation, sorting, indexing, storage retrieval and security
* Desktop publishing;
	+ - Designing and developing desktop publishing tools
		- Manipulation of desktop publishing tools
		- Enhancement of typeset work and printing documents
* Presentation Packages;
	+ - Types of presentation Packages
		- Creating, formulating, running, editing, printing and presenting slides and handouts
* Networking and Internet;
	+ - Computer networking and internet.
		- Electronic mail and world wide web
* Emerging trends and issues in ICT;
	+ - Identify and integrate emerging trends and issues in ICT
		- Challenges posed by emerging trends and issues

**EVIDENCE** **GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:* 1. Identified and controlled security threats
	2. Detected and protected computer crimes
	3. Applied word processing in office tasks
	4. Designed, prepared work sheet and applied data to the cells in accordance to workplace procedures
	5. Opened electronic mail for office communication as per workplace procedure
	6. Installed internet and World Wide Web for office tasks in accordance with office procedures
	7. Integrated emerging issues in computer ICT applications
	8. Applied laws governing protection of ICT
 |
| 1. Resource Implications
 |  The following resources should be provided:* 1. Access to relevant workplace where assessment can take place
	2. Appropriately simulated environment where assessment can take place
 |
| 1. Methods of Assessment
 | Competency may be assessed through:* 1. Observation
	2. Oral questioning
	3. Written test
	4. Portfolio of Evidence
	5. Interview
	6. Third party report
 |
| 1. Context of Assessment
 | Competency may be assessed:1. On-the-job
2. Off-the –job
3. During Industrial attachment
 |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# DEMONSTRATE ENTREPRENEURIAL SKILLS

**UNIT CODE :** ENG/OS/MAR/BC/03/6/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** | **PERFORMANCE CRITERIA**  |
| 1. Demonstrate understanding of an entrepreneur
 | 1. Entrepreneurs and Business persons are distinguished as per principles of entrepreneurship
2. ***Types of entrepreneurs*** are identified as per principles of entrepreneurship
3. Ways of becoming an Entrepreneur are identified as per principles of Entrepreneurship
4. ***Characteristics of Entrepreneurs*** are identified as per principles of Entrepreneurship
5. Factors affecting Entrepreneurship development are explored as per principles of Entrepreneurship
 |
| 1. Demonstrate understanding of Entrepreneurship and self-employment
 | 1. Entrepreneurship and self-employment are distinguished as per principles of entrepreneurship
2. Importance of self-employment is analysed based on business procedures and strategies
3. ***Requirements for entry into self-employment*** are identified according to business procedures and strategies
4. Role of an Entrepreneur in business is determined according to business procedures and strategies
5. Contributions of Entrepreneurs to National development are identified as per business procedures and strategies
6. Entrepreneurship culture in Kenya is explored as per business procedures and strategies
7. Born or made Entrepreneurs are distinguished as per entrepreneurial traits
 |
| 1. Identify Entrepreneurship opportunities
 | 1. Sources of business ideas are identified as per business procedures and strategies
2. Business ideas and opportunities are generated as per business procedures and strategies
3. Business life cycle is analysed as per business procedures and strategies
4. Legal aspects of business are identified as per procedures and strategies
5. Product demand is assessed as per market strategies
6. Types of ***business environment*** are identified and evaluated as per business procedures
7. Factors to consider when evaluating business environment are explored based on business procedure and strategies
8. Technology in business is incorporated as per best practice
 |
| 1. Create entrepreneurial awareness
 | 1. ***Forms of businesses*** are explored as per business procedures and strategies
2. Sources of business finance are identified as per business procedures and strategies
3. Factors in selecting source of business finance are identified as per business procedures and strategies
4. ***Governing policies*** on Small Scale Eenterprises (SSEs) are determined as per business procedures and strategies
5. Problems of starting and operating SSEs are explored as per business procedures and strategies
 |
| 1. Apply entrepreneurial motivation
 | 1. ***Internal and external motivation*** factors are determined in accordance with motivational theories
2. Self-assessment is carried out as per entrepreneurial orientation
3. Effective communications are carried out in accordance with communication principles
4. Entrepreneurial motivation is applied as per motivational theories
 |
| 1. Develop innovative business strategies
 | 1. Business innovation strategies are determined in accordance with the organization strategies
2. Creativity in business development is demonstrated in accordance with business strategies
3. ***Innovative business strategies*** are developed as per business principles
4. Linkages with other entrepreneurs are created as per best practice
5. ICT is incorporated in business growth and development as per best practice
 |
| 1. Develop Business Plan
 | 1. Identified Business is described as per business procedures and strategies
2. Marketing plan is developed as per business plan format
3. Organizational/Management plan is prepared in accordance with business plan format
4. Production/operation plan in accordance with business plan format
5. Financial plan is prepared in accordance with the business plan format
6. Executive summary is prepared in accordance with business plan format
7. Business plan is presented as per best practice
 |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range**  |
| 1. Types of entrepreneurs may include but not limited to:
 | * Innovators
* Imitators
* Craft
* Opportunistic
* Speculators
 |
| 1. Characteristics of Entrepreneurs may include but not limited to:
 | * Creative
* Innovative
* Planner
* Risk taker
* Networker
* Confident
* Flexible
* Persistent
* Patient
* Independent
* Future oriented
* Goal oriented
 |
| 1. Requirements for entry into self-employment may include but not limited to
 | * Technical skills
* Management skills
* Entrepreneurial skills
* Resources
* Infrastructure
 |
| 1. Internal and external motivation may include but not limited to:
 | * Interest
* Passion
* Freedom
* Prestige
* Rewards
* Punishment
* Enabling environment
* Government policies
 |
| 1. Business environment may include but not limited to:
 | * External
* Internal
* Intermediate
 |
| 1. Forms of businesses may include but not limited to:
 | * Sole proprietorship
* Partnership
* Limited companies
* Cooperatives
 |
| 1. Governing policies may include but not limited to:
 | * Increasing scope for finance
* Promoting cooperation between entrepreneurs and private sector
* Reducing regulatory burden on entrepreneurs
* Developing IT tools for entrepreneurs
 |
| 1. Innovative business strategies may include but not limited to:
 | * New products
* New methods of production
* New markets
* New sources of supplies
* Change in industrialization
 |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Analytical
* Management
* Problem-solving
* Root-cause analysis
* Communication

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Decision making
* Business communication
* Change management
* Competition
* Risk
* Net working
* Time management
* Leadership
* Factors affecting entrepreneurship development
* Principles of Entrepreneurship
* Features and benefits of common operational practices, e. g., continuous improvement (kaizen), waste elimination,
* Conflict resolution
* Health, safety and environment (HSE) principles and requirements
* Customer care strategies
* Basic financial management
* Business strategic planning
* Impact of change on individuals, groups and industries
* Government and regulatory processes
* Local and international market trends
* Product promotion strategies
* Market and feasibility studies
* Government and regulatory processes
* Local and international business environment
* Relevant developments in other industries
* Regional/ County business expansion strategies

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | 1. Assessment requires evidence that the candidate:
2. Distinguished entrepreneurs and businesspersons correctly
3. Identified ways of becoming an entrepreneur appropriately
4. Explored factors affecting entrepreneurship development appropriately
5. Analysed importance of self-employment accurately
6. Identified requirements for entry into self-employment correctly
7. Identified sources of business ideas correctly
8. GeneratedBusiness ideas and opportunities correctly
9. Analysed business life cycle accurately
10. Identified legal aspects of business correctly
11. Assessed product demand accurately
12. Determined Internal and external motivation factors appropriately
13. Carried out communications effectively
14. Identified sources of business finance correctly
15. Determined Governing policy on small scale enterprise appropriately
16. Explored problems of starting and operating SSEs effectively
17. Developed Marketing, Organizational/Management, Production/Operation and Financial plans correctly
18. Prepared executive summary correctly
19. Determined business innovative strategies appropriately
20. Presented business plan effectively
 |
| 1. Resource Implications
 | The following resources should be provided:1. Access to relevant workplace where assessment can take place
2. Appropriately simulated environment where assessment can take place
 |
| 1. Methods of Assessment
 | 1. Written tests
2. Oral questions
3. Third party report
4. Interviews
5. Portfolio of Evidence
 |
| 1. Context of Assessment
 | Competency may be assessed 1. On-the-job
2. Off-the –job
3. During Industrial attachment
 |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# DEMONSTRATE EMPLOYABILITY SKILLS

**UNIT CODE:** ENG/OS/MAR/BC/04/6/A

**UNIT DESCRIPTON**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| 1. Conduct self-management
 | 1. Personal vision, mission and goals are formulated based on potential and in relation to organization objectives
2. Emotional intelligence is demonstrated as per workplace requirements.
3. Individual performance is evaluated and monitored according to the agreed targets.
4. Assertiveness is developed and maintained based on the requirements of the job.
5. Accountability and responsibility for own actions are demonstrated based on workplace instructions.
6. Self-esteem and a positive self-image are developed and maintained based on values.
7. Time management, attendance and punctuality are observed as per the organization policy.
8. Goals are managed as per the organization’s objective
9. Self-strengths and weaknesses are identified based on personal objectives
 |
| 1. Demonstrate interpersonal communication
 | 1. Writing skills are demonstrated as per communication policy
2. Negotiation and persuasion skills are demonstrated as per communication policy
3. Internal and external stakeholders’ needs are identified and interpreted as per the communication policy
4. Communication networks are established based on workplace policy
5. Information is shared as per communication policy

  |
| 1. Demonstrate critical safe work habits
 | * 1. Stress is managed in accordance with workplace policy.
	2. Punctuality and time consciousness is demonstrated in line with workplace policy.
	3. Personal objectives are integrated with organization goals based on organization’s strategic plan.
	4. ***Resources*** are utilized in accordance with workplace policy.
	5. Work priorities are set in accordance to workplace goals and objectives.
	6. Leisure time is recognized and utilized in line with personal objectives.
	7. ***Drugs and substances of abuse*** are identified and avoided based on workplace policy.
	8. HIV and AIDS prevention awareness is demonstrated in line with workplace policy.
	9. Safety consciousness is demonstrated in the workplace based on organization safety policy.
	10. ***Emerging issues*** are identified and dealt with in accordance with organization policy.
 |
| 1. Lead a workplace team
 | 1. Performance targets for the ***team*** are set based on organization’s objectives
2. Duties are assigned in accordance with the organization policy.
3. ***Forms of communication*** in a team are established according to organization’s policy.
4. Team performance is evaluated based on set targets as per workplace policy.
5. Conflicts are resolved between team members in line with organization policy.
6. Gender related issues are identified and mainstreamed in accordance workplace policy.
7. Human rights and fundamental freedoms are identified and respected as Constitution of Kenya 2010.
8. Healthy relationships are developed and maintained in line with workplace.
 |
| 1. Plan and organize work
 | 1. Work plans are prepared based on activities and budget.
2. Assigned tasks are interpreted and expectations identified as per the workplace instructions.
3. Task occupational safety and health requirements are identified and observed regulations.
4. Work resources are identified, mobilized, allocated and utilized based on organization work plans.
5. Work activities are monitored and evaluated in line with work plans and workplace policy.
6. Work plans are reviewed based on target and available resources.
 |
| 1. Maintain professional growth and development
 | * 1. Personal training needs are identified and assessed in line with the requirements of the job.
	2. ***Training and career opportunities*** are identified and utilized based on job requirements.
	3. Resources for training are mobilized and allocated based organizations and individual skills needs.
	4. Licensees and certifications relevant to job and career are obtained and renewed as per policy.
	5. Work priorities and personal commitments are balanced and managed based on requirements of the job and personal objectives.
	6. Recognitions are sought as proof of career advancement in line with professional requirements.
 |
| 1. Demonstrate workplace learning
 | * 1. Learning opportunities are sought and managed based on job requirement and organization policy.
	2. Improvement in performance is demonstrated based on courses attended.
	3. Application of learning is demonstrated in both technical and non-technical aspects based on requirements of the job
	4. Time and effort is invested in learning new skills based on job requirements
	5. Initiative is taken to create more effective and efficient processes and procedures in line with workplace policy.
	6. New systems are developed and maintained in accordance with the requirements of the job.
	7. Awareness of personal role in workplace ***innovation*** is demonstrated based on requirements of the job.
 |
| 1. Demonstrate problem solving skills
 | * 1. Creative, innovative and practical solutions are developed based on the problem
	2. Independence and initiative in identifying and solving problems is demonstrated based on requirements of the job.
	3. Team problems are solved as per the workplace guidelines
	4. Problem solving strategies are applied as per the workplace guidelines
	5. Problems are analyzed and assumptions tested as per the context of data and circumstances
 |
| 1. Manage ethical performance
 | * 1. Policies and guidelines are observed as per the workplace requirements
	2. Self-worth and professionalism is exercised in line with personal goals and organizational policies
	3. Code of conduct is observed as per the workplace requirements
	4. Integrity is demonstrated as per legal requirement
 |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Drug and substance abuse may include but not limited to:
 | Commonly abused* Alcohol
* Tobacco
* Miraa
* Over-the-counter drugs
* Cocaine
* Bhang
* Glue
 |
| 1. Feedback may include but not limited to:
 | * Verbal
* Written
* Informal
* Formal
 |
| 1. Relationships may include but not limited to:
 | * Man/Woman
* Trainer/trainee
* Employee/employer
* Client/service provider
* Husband/wife
* Boy/girl
* Parent/child
* Sibling relationships
 |
| 1. Forms of communication may include but not limited to:
 | * Written
* Visual
* Verbal
* Non verbal
* Formal and informal
 |
| 1. Team may include but not limited to:
 | * Small work group
* Staff in a section/department
* Inter-agency group
 |
| 1. Personal growth may include but not limited to:
 | * Growth in the job
* Career mobility
* Gains and exposure the job gives
* Net workings
* Benefits that accrue to the individual as a result of noteworthy performance
 |
| 1. Personal objectives may include but not limited to:
 | * Long term
* Short term
* Broad
* Specific
 |
| 1. Trainings and career opportunities may includes but not limited to
 | * Participation in training programs
* Serving as Resource Persons in conferences and workshops
 |
| 1. Resource may include may but not limited to:
 | * Human
* Financial
* Technology
 |
| 1. Innovation may include but not limited to:
 | * New ideas
* Original ideas
* Different ideas
* Methods/procedures
* Processes
* New tools
 |
| 1. Emerging issues may include but not limited to:
 | * Terrorism
* Social media
* National cohesion
* Open offices
 |
| 1. Range of media for learning may include but not limited to:
 | * Mentoring
* peer support and networking
* IT and courses
 |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Interpersonal
* Communication
* Critical thinking
* Organizational
* Negotiation
* Monitoring
* Evaluation
* Record keeping
* Problem solving
* Decision Making
* Resource utilization
* Resource mobilization

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Work values and ethics
* Company policies
* Company operations, procedures and standards
* Occupational Health and safety procedures
* Fundamental rights at work
* Workplace communication
* Concept of time
* Time management
* Decision making
* Types of resources
* Work planning
* Organizing work
* Monitoring and evaluation
* Record keeping
* Gender mainstreaming
* HIV and AIDS
* Drug and substance abuse
* Professional growth and development
* Technology in the workplace
* Innovation
* Emerging issues

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency
 | Assessment requires evidence that the candidate:* 1. Conducted self-management
	2. Demonstrated interpersonal communication
	3. Demonstrated critical safe work habits
	4. Demonstrated the ability to lead a workplace team
	5. Planned and organized work
	6. Maintained professional growth and development
	7. Demonstrated workplace learning
	8. Demonstrated problem solving skills
	9. Demonstrated the ability to manage performance ethically
 |
| 1. Resource Implications
 | The following resources should be provided:1. Access to relevant workplace where assessment can take place
2. Appropriately simulated environment where assessment can take place
 |
| 1. Methods of Assessment
 | Competency in this unit may be assessed through: 1. Observation
2. Oral questioning
3. Written test
4. Portfolio of Evidence
5. Interview
6. Third party report
 |
| 1. Context of Assessment
 | Competency may be assessed:1. On-the-job
2. Off-the –job
3. During Industrial attachment
 |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# DEMONSTRATE ENVIRONMENTAL LITERACY

**UNIT CODE:** ENG/OS/MAR/BC/05/6/A

**UNIT DESCRIPTION**

This unit specifies the competencies required to demonstrate environmental literacy. It involves, controlling environmental hazard and environmental pollution, demonstrating sustainable resource use, evaluating current practices in relation to resource usage, identifying environmental legislations/conventions for environmental concerns, implementing specific environmental programs, monitoring activities on environmental protection/Programs, analyzing resource use and developing resource conservation plans

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| 1. Control environmental hazard
 | 1. Storage methods for environmentally hazardous materials are strictly followed according to environmental regulations and OSHS.
2. Disposal methods of hazardous wastes are followed according to environmental regulations and OSHS.
3. ***PPE*** is used according to OSHS.
 |
| 1. Control environmental Pollution
 | * 1. Environmental pollution ***control measures*** are implemented in accordance with international protocols.
	2. Procedures for solid waste management are observed according Environmental Management and Coordination Act 1999
	3. Methods for minimizing noise pollution is complied with based on Noise and Excessive Vibration Pollution and Control Regulations, 2009
 |
| 1. Demonstrate sustainable resource use
 | * 1. Methods for minimizing wastage are complied with based on organizational waste management guide
	2. Waste management procedures are employed following principles of 3Rs (Reduce, Reuse, Recycle)
	3. Methods for economizing and reducing resource consumption are practiced as per the Constitution of Kenya 2010 Article 69.
 |
| 1. Evaluate current practices in relation to resource usage
 | * 1. Information on resource efficiency systems and procedures are collected and provided as per work groups/sector
	2. Current resource usage is measured and recorded as per work group
	3. Current purchasing strategies are analyzed and recorded according to industry procedures.
	4. Current work processes to access information and data is analyzed following enterprise protocol.
 |
| 1. Identify environmental legislations/conventions for environmental concerns
 | 1. Environmental legislations/conventions and local ordinances are identified according to the different environmental aspects/impact
2. Industrial standard/environmental practices are described according to the different environmental concerns
 |
| 1. Implement specific environmental programs
 | 1. Programs/Activities are identified according to organizations policies and guidelines.
2. Individual roles/responsibilities are determined and performed based on the activities identified.
3. Problems/constraints encountered are resolved in accordance with organizations’ policies and guidelines
4. Stakeholders are consulted based on company guidelines
 |
| 1. Monitor activities on Environmental protection/Programs
 | 1. Activities are periodically monitored and Evaluated according to the objectives of the environmental program
2. Feedback from stakeholders are gathered and considered in Proposing enhancements to the program based on consultations
3. Data gathered are analyzed based on Evaluation requirements
4. Recommendations are submitted based on the findings
5. Management support systems are set/established to sustain and enhance the program
6. Environmental incidents are monitored and reported to
7. concerned/proper authorities
 |
| 1. Analyze resource use
 | 1. All resource consuming processes are Identified as per the organizational work plan
2. Quantity and nature of resource consumed is determined based on processes
3. Resource flow is analyzed as per different parts of the process.
4. Wastes are classified according to NEMA regulations on waste management.
 |
| 1. Develop resource Conservation plans
 | 9.1. Efficiency of use/conversion of resources is determined according to industry protocol.9.2. Causes of low efficiency of use of resources are Determined based on industry protocol.9.3. Plans for increasing the efficiency of resource use are developed based on findings. |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| PPE may include but not limited to | * Mask
* Gloves
* Goggles
* Safety hat
* Overall
* Hearing protector
 |
| Control measures may include but not limited to | * Methods for minimizing or stopping spread and ingestion of airborne particles
* Methods for minimizing or stopping spread and ingestion of gases and fumes
* Methods for minimizing or stopping spread and ingestion of liquid wastes
 |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* + Measuring
	+ Recording
	+ Analytical
	+ Monitoring
	+ Communication
	+ Writing

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* + PPEs
	+ Environmental regulations
	+ OSHS
	+ Pollution
	+ Waste management
	+ Principle of 3Rs
	+ Types of resources
	+ Techniques in measuring current usage of resources
	+ Environmental hazards
	+ Regulatory requirements

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:* 1. Controlled environmental hazard
	2. Controlled environmental pollution
	3. Demonstrated sustainable resource use
	4. Evaluated current practices in relation to resource usage
	5. Demonstrated knowledge of environmental legislations and local ordinances according to the different environmental issues /concerns.
	6. Described industrial standard environmental practices according to the different environmental issues/concerns.
	7. Resolved problems/ constraints encountered based on management standard procedures
	8. Implemented and monitored environmental practices on a periodic basis as per company guidelines
	9. Recommended solutions for the improvement of the program
	10. Monitored and reported to proper authorities any environmental incidents
 |
| 1. Resource Implications
 | The following resources should be provided:* 1. Workplace with storage facilities
	2. Tools, materials and equipment relevant to the tasks (e.g. Cleaning tools, cleaning materials, trash bags)
	3. PPE, manuals and references
	4. Legislation, policies, procedures, protocols and local ordinances relating to environmental protection
	5. Case studies/scenarios relating to environmental Protection
 |
| 1. Methods of Assessment
 | Competency in this unit may be assessed through:* 1. Observation
	2. Oral questioning
	3. Written test
	4. Portfolio of Evidence
	5. Interview
	6. Third party report
 |
| 1. Context of Assessment
 | Competency may be assessed 1. On-the-job
2. Off-the –job
3. During Industrial attachment
 |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE:** ENG/OS/MAR/BC/06/6/A

**UNIT DESCRIPTION**

This unit specifies the competencies required to demonstrate occupational health and safety practices. It involves identifying workplace hazards and risks, identifying and implementing appropriate control measures to hazards and risks and implementing OSH programs, procedures and policies/guidelines.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| 1. Identify workplace hazards and risk
 | 1.1 ***Hazards*** in the workplace are identified ***based their indicators*** 1.2 Risks and hazards are evaluated based on legal requirements.1.3 ***OSH concerns*** raised by workers are addressed as per legal requirements.  |
| 1. Control OSH hazards
 | 2.1 Hazard prevention ***and control measures*** are implemented as per legal requirement.2.2 Risk assessment is conductedand a risk matrix developed based on likely impact.2.3 ***Contingency measures***, including ***emergency procedures*** during workplace ***incidents and emergencies*** are recognized and established in accordance with organization procedures. |
| 1. Implement OSH programs
 | 3.1 Company OSH program are identified, evaluated and reviewed based on legal requirements.3.2 Company OSH programs are implemented as per legal requirements.3.3 Workers are capacity built on OSH standards and procedures as per legal requirements3.4 ***OSH-related records*** are maintained as per legal requirements. |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Hazards may include but not limited to:
 | * Physical hazards – impact, illumination, pressure, noise,
* vibration, extreme temperature, radiation
* Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects
* Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors
* Ergonomics
* Psychological factors – over exertion/ excessive force,
* awkward/static positions, fatigue, direct pressure,
* varying metabolic cycles
* Physiological factors – monotony, personal relationship, work out cycle
* Safety hazards (unsafe workplace condition) –confined space, excavations, falling objects, gas leaks, electrical, poor storage of materials and waste, spillage, waste and debris
* Unsafe workers’ act (Smoking in off-limited areas, Substance and alcohol abuse at work)
 |
| 1. Indicators may include but not limited to:
 | * Increased of incidents of accidents, injuries
* Increased occurrence of sickness or health complaints/ symptoms
* Common complaints of workers related to OSH
* High absenteeism for work-related reasons
 |
| 1. OSH concerns may include but not limited to:
 | * Workers’ experience/observance on presence of work hazards
* Unsafe/unhealthy administrative arrangements (prolonged work hours, no break time, constant overtime, scheduling of tasks)
* Reasons for compliance/non-compliance to use of PPEs or other OSH procedures/policies/guidelines
 |
| 1. Safety gears /PPE (Personal Protective Equipment) may include but not limited to:
 | * Arm/Hand guard, gloves
* Eye protection (goggles, shield)
* Hearing protection (ear muffs, ear plugs)
* Hair Net/cap/bonnet
* Hard hat
* Face protection (mask, shield)
* Apron/Gown/coverall/jump suit
* Anti-static suits
* High-visibility reflective vest
 |
| 1. Appropriate risk controls

may include but not limited to: | * Appropriate risk controls in order of impact are as follows:
* Eliminate the hazard altogether (i.e., get rid of the dangerous machine)
* Isolate the hazard from anyone who could be harmed (i.e., keep the machine in a closed room and operate it remotely; barricade an unsafe area off)
* Substitute the hazard with a safer alternative (i.e., replace the machine with a safer one)
* Use administrative controls to reduce the risk (i.e., train workers how to use equipment safely; train workers about the risks of harassment; issue signage)
* Use engineering controls to reduce the risk (i.e., attach guards to the machine to protect users)
* Use personal protective equipment (i.e., wear

gloves and goggles when using the machine) |
| 1. Contingency measures may include but not limited to:
 | * Evacuation
* Isolation
* Decontamination
* (Calling designed) emergency personnel
 |
| 1. Incidents and emergencies may include but not limited to:
 | * Chemical spills
* Equipment/vehicle accidents
* Explosion
* Fire
* Gas leak
* Injury to personnel
* Structural collapse
* Toxic and/or flammable vapors emission.
 |
| 1. OSH-related Records may include but not limited to:
 | * Medical/Health records
* Incident/accident reports
* Sickness notifications/sick leave application
* OSH-related trainings obtained
 |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Interpersonal
* Presentation
* Risk assessment
* Evaluation
* Critical thinking
* Problem solving
* Negotiation

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* General OSH Principles
* Occupational hazards/risks recognition
* OSH organizations providing services on OSH evaluation and/or work environment measurements (WEM)
* National OSH regulations; company OSH policies and protocols
* Systematic gathering of OSH issues and concerns
* General OSH principles
* National OSH regulations
* Company OSH and recording protocols, procedures and policies/guidelines
* Training and/or counseling methodologies and strategies

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:1. Identified hazards in the workplace based their indicators
2. Evaluated workplace hazards based on legal requirements.
3. Addressed OSH concerns raised by workers as per legal requirements.
4. Implemented hazard prevention and control measures as per legal requirement.
5. Conducted risk assessment as per legal requirement.
6. Developed risk matrix based on likely impact.
7. Recognized and established contingency measures in accordance with organization procedures.
8. Identified, evaluated and reviewed company OSH program based on legal requirements.
9. Implemented company OSH programs as per legal requirements.
10. Capacity built workers on OSH standards and procedures as per legal requirements
11. Maintained OSH-related records as per legal requirements.
 |
| 1. Resource Implications
 | The following resources should be provided:1. Access to relevant workplace where assessment can take place
2. Appropriately simulated environment where assessment can take place
 |
| 1. Methods of Assessment
 | Competency in this unit may be assessed through: 1. Observation
2. Oral questioning
3. Written test
4. Portfolio of Evidence
5. Interview
6. Third party report
 |
| 1. Context of Assessment
 | Competency may be assessed:1. On-the-job
2. Off-the –job
3. During Industrial attachment
 |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# COMMON COMPETENCIES

# APPLY MECHANICAL SCIENCE PRINCIPLES

**UNIT CODE:** ENG/OS/MAR/CC/01/6/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of Mechanical science principles in their work. It includes determining forces in a system, demonstrating knowledge of moments, understanding friction principles, understanding motions in engineering, describing work, energy and power, performing machine calculations, demonstrating gas principles, applying heat knowledge, applying density knowledge and applying pressure principles.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Determine forces in a system
 | * 1. Forces are defined and described
	2. ***Force’s theorems*** are described and applied
	3. Types of force are described and applied
	4. Calculations involving forces are determined
	5. Resultant of coplanar forces are determined.
 |
| 1. Demonstrate knowledge of moments
 | * 1. Moments are defined
	2. Moments are calculated
	3. Principles of moments are described and applied
	4. Couples are identified and applied in engineering systems.
 |
| 1. Understand friction principles
 | * 1. Friction and applications are defined
	2. Laws of friction are identified and applied
	3. Limiting friction is calculated
	4. Forces applied at an angle to a horizontal plane are calculated
	5. Coefficient of friction is calculated
	6. Advantages and disadvantages of friction are identified.
 |
| 1. Understand motions in engineering
 | * 1. Motion concepts are discussed
	2. Laws of motion are identified and applied
	3. Motion calculations are performed
	4. Displacement/time graphs are applied
 |
| 1. Describe work, energy and power
 | * 1. Work, energy and power are defined
	2. Work is calculated
	3. Energy is calculated
	4. Power calculations are performed
	5. Work, energy and power are applied
 |
| 1. Perform machine calculations
 | * 1. Machine is defined and types identified
	2. Mechanics of Machines are calculated
	3. ***Problems on simple machines*** are solved
	4. Problems on levers are solved
	5. Laws of machines are identified
	6. Efficiency of machine is calculated
	7. Machine Safety Factor is calculated
 |
| 1. Demonstrate gas principles
 | * 1. ***Gas laws*** are identified
	2. Gas laws are applied in solving engineering problems
	3. Uses of gases in engineering systems are identified
	4. Gas handling and transportation procedures are identified
 |
| 1. Apply heat knowledge
 | * 1. Heat concepts are discussed and applied
	2. Working principle of heat is defined
	3. Heat capacity is discussed
	4. Heat problems are solved
	5. Heat transfer and heat loss is discussed and applied
 |
| 1. Apply density knowledge
 | * 1. Density is defined
	2. ***Density terminology*** are discussed
	3. Density measurements are carried out
	4. Density problems are solved and applied
 |
| 1. Apply pressure principles
 | * 1. Pressure is defined
	2. Pressure concepts are discussed and applied
	3. Working principles of pressure is discussed
	4. Pressure problems are solved
	5. ***Pressure applications*** are identified
 |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range**  |
| Force’s theorems May include but not limited to: | * + Parallelogram
	+ Triangle
	+ Polygon
	+ Irregular Shapes
	+ Circular shapes
 |
| Problems on simple machines May include but not limited to: | * + Mechanics of Machines
	+ Machine advantage
	+ Velocity ratio
	+ Efficiency
 |
| Gas laws May include but not limited to: | * + Boyles law
	+ Charles law
	+ Gas equation
 |
| Density terminology May include but not limited to: | * + Density
	+ Relative density
 |
| Pressure applications May include but not limited to: | * + Vacuum pump
	+ Hydraulic pump
	+ Hydrometers
	+ Gravity
 |
| Principles May include but not limited to: | * + Newton’s laws of motion
	+ Law of conservation of linear momentum
	+ Law of conservation of energy
	+ Archimedes’ principle
 |
| Mechanical calculations May include but not limited to: | * + Mechanical advantage
	+ Efficiency
	+ Torque
	+ Power/Energy
	+ Work done
	+ Safety Factor
 |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Apply basic mechanical formulas
* Use of basic mechanical machines
* Perform various unit conversions of mechanical quantities to SI Units
* Basic mechanical systems design
* Mechanical machine operation
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Metrology

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Newton’s law
* Levers
* Gear trains
* Laws of conservation of energy
* Laws of friction
* Type of forces
* Thermodynamics
* Mechanical advantage and efficiency calculations
* Properties of materials
* Gas laws
* SI units of mechanical energy.
* Power transmission systems
* Operation of mechanical machines
* Mechanical calculation of power, energy, work done, torque and safety factor
* Units of measurement, conversions and abbreviations

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range

|  |  |
| --- | --- |
| 1. Critical aspects of Competency
 | Assessment requires evidence that the candidate: * + Determined forces in a system
	+ Demonstrated knowledge of moments
	+ Understood friction principles
	+ Understood motions in engineering
	+ Described work, energy and power
	+ Performed machine calculations
	+ Demonstrated gas principles
	+ Applied heat knowledge
	+ Applied density knowledge
	+ Applied pressure principles
	+ Applied Mechanics of Machines Principles
	+ Applied Thermodynamics Principles
 |
| 1. Resource Implications
 | The following resources should be provided: * + Mechanical Engineering Laboratory and workshop
	+ Access to relevant workplace or appropriately simulated environment where assessment can take place
	+ Measuring tools and equipment
	+ Sample materials to be tested
 |
| 1. Methods of Assessment
 | Competency in this unit may be assessed through: * 1. Direct Observation
	2. Demonstration with Oral Questioning
	3. Case studies
	4. Written tests
	5. Projects
 |
| 1. Context of Assessment
 | Competency may be assessed individually in the actual workplace orthrough accredited institution  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# APPLY FLUID MECHANICS PRINCIPLES

**UNIT CODE:** ENG/OS/MAR/CC/02/6/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Understand flow of fluids
 | * 1. Flow rate is defined and calculated
	2. Types of flow are discussed
	3. Flow rate in pipes is measured
	4. Losses in pipes are determined
	5. ***Causes of losses*** in pipes are determined
	6. Flow losses equations are applied in problem solving
	7. Methods of regulating flow rate are discussed and applied
	8. Flow constant is determined
 |
| 1. Demonstrate knowledge in viscous flow
 | * 1. Viscosity is defined
	2. Principles of viscosity are discussed and applied
	3. Calculations on Viscosity are discussed and applied
	4. Viscous flow between parallel surfaces is explained
	5. Viscous flow equations between parallel surfaces are derived and applied
	6. Viscous flow equations in circular pipes are derived and applied in problem solving
	7. Coefficient of viscosity is derived and applied
 |
| 1. Perform dimensional analysis
 | * 1. Dimensional analysis is explained
	2. Principle of dimensional homogeneity is explained
	3. Fundamental dimensions are stated
	4. Dimensional units are defined
	5. ***Physical quantities*** are identified
	6. Dimensional analysis is ***applied*** in problem solving
 |
| Demonstrate understanding of fluid pumps | * 1. ***Principle of operation*** of pumps is described
	2. ***Reciprocating pump equation is*** ***derived***
	3. ***Centrifugal pump equation is derived***
	4. Pump equations are applied in problem solving
	5. Pump parameters are discussed
	6. Pump selection and pump types is discussed
 |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range**  |
| Types of flow May include but not limited to: | * + Laminar
	+ Turbulent
 |
| Causes of losses May include but not limited to: | * + Friction
	+ Enlargement/reduction in cross-sectional areas
	+ Elevation and Topography
	+ Flow distance
	+ Pump rating
	+ Leakages
 |
| Physical quantities May include but not limited to: | * + Mass
	+ Weight
	+ Force
	+ Density
	+ Velocity
	+ Acceleration
	+ Viscosity
	+ Temperature
 |
| Applied May include but not limited to: | * + Reynolds number
	+ Mach number
	+ Froude number
	+ Bernoulli’s Equation
	+ Poiseuille’s Equation
	+ Chezy-Dacy Equation
 |
| Principle of operation May include but not limited to: | * + Reciprocating
	+ Centrifugal
	+ Linear
 |
| Reciprocating pump equation is derived May include but not limited to: | * + Coefficient of discharge
	+ Percentage slip
	+ Work done
	+ Acceleration head
	+ Pressure head in the cylinder
 |
| Centrifugal pump equation is derived May include but not limited to: | * + Effective head
	+ Manometric head
	+ Manometric efficiency
	+ Mechanical efficiency
	+ Discharge
	+ Torque
	+ Work done unit weight
	+ Specific speed
 |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Apply basic mechanical formulas
* Use of basic mechanical machines
* Perform various unit conversions of mechanical quantities
* Basic mechanical systems design
* Mechanical machine operation
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Metrology
* Fluid Mechanics
* Plumbing Works

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Newton’s law
* Levers
* Gear trains
* Laws of conservation of energy
* Laws of friction
* Type of forces
* Thermodynamics
* Calculation of fluid pressure and flow rate
* Mechanical advantage and efficiency calculations
* Gas laws
* SI units of mechanical energy.
* Parameters of fluid system
* Operation of mechanical machines
* Mechanical calculation of power, energy, work done, torque and safety factor
* Units of measurement, conversions and abbreviations

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency
 | Assessment requires evidence that the candidate: * + Identified Principlesof Fluid Mechanics
	+ Performed mechanical calculations of a system
	+ Identified types of forces in fluid flow
	+ Calculated resultant forces on plane framework
	+ Identified application of forces on the production flow
	+ Tested mechanical properties of fluids
	+ Identified tools and equipment for measuring system parameters
	+ Recorded and interpreted measured parameters.
	+ Operated fluid handling and storage systems
 |
| 1. Resource Implications
 | The following resources should be provided: * + Mechanical Engineering Laboratory and workshop
	+ Access to relevant workplace or appropriately simulated environment where assessment can take place
	+ Measuring tools and equipment
	+ Sample materials to be tested
 |
| 1. Methods of Assessment
 | Competency in this unit may be assessed through: * + Direct Observation
	+ Demonstration with Oral Questioning
	+ Case studies
	+ Written tests
	+ Projects
 |
| 1. Context of Assessment
 | Competency may be assessed individually in the actual workplace orthrough accredited institution  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# APPLY THERMODYNAMICS PRINCIPLES

**UNIT CODE:** ENG/OS/MAR/CC/03/6/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Understand fundamentals of thermodynamics
 | * 1. Thermodynamics is defined
	2. Terms used in thermodynamics are described
	3. Thermodynamics processes and cycles are described
	4. Law’s thermodynamics are applied
 |
| 1. Perform steady flow processes
 | * 1. Steady flow is defined
	2. Factors leading to steady flow are discussed
	3. Steady flow energy equation is derived
	4. Steady flow energy equation is applied in problem solving
	5. Steady flow energy equation is applied in ***utilities***
 |
| 1. Perform non-steady flow processes
 | * 1. Non-steady Flow is defined
	2. Factors leading to non-steady flow are discussed
	3. Non-steady flow energy equation is derived
	4. Non-steady flow energy equation is applied in problem solving
 |
| 1. Understand perfect gases
 | * 1. Perfect Gas is defined
	2. ***Perfect gas laws*** are stated
	3. Gas laws experiment are carried out
	4. Gas laws are applied
 |
| 1. Generate steam
 | * 1. Principle of Steam Generation is discussed and applied
	2. Heat Loss and heat retention in steam generation is discussed
	3. Dryness fraction is determined
	4. Relationship between pressure and boiling point is determined
	5. Energy balance is carried out
	6. Relationship between temperature and pressure is determined.
 |
| 1. Perform thermodynamics reversibility and entropy
 | * 1. Thermodynamics reversibility is explained
	2. Principles of heat engine are explained
	3. Second law of thermodynamics is applied
	4. Entropy is explained in thermodynamics cycle
	5. Second Law of Thermodynamics is applied in calculations
 |
| 1. Understand ideal gas cycle
 | * 1. Ideal gas cycle processes are explained
	2. Air standard efficiency and actual efficiency are differentiated
	3. Problems are solved in ideal gas cycle
 |
| 1. Demonstrate understanding of fuel and combustion
 | * 1. Fuels are classified
	2. Properties of fuels are described
	3. Combustion equation are derived
	4. Combustion equation is applied to combustion and exhaust gas problems
 |
| 1. Perform heat transfer
 | * 1. Principle of heat transfer is discussed
	2. Heat transfer equations are derived and applied from Fourier’s law
	3. Heat transfer equation is derived and applied from Newton’s law of cooling and Fourier’s law
 |
| 1. Understand heat exchangers
 | * 1. Principle of Operation of Heat Exchangers is discussed
	2. Heat exchangers are classified
	3. Recuperative heat exchangers are described
	4. Heat equations are applied to solve heat exchanger problems
 |
| 1. Understand air compressors
 | * 1. Principle of operation of Air Compressors is discussed.
	2. Air compressors are classified
	3. ***Types of air compressors*** are described
	4. Equations of reciprocating compressors are derived and applied
 |
| 1. Understand gas turbines
 | * 1. Principle of operation of Gas Turbines is discussed
	2. Theoretical cycle for gas turbines is explained
	3. Open cycle gas turbine is described
	4. Closed cycle gas turbine is described
	5. Gas turbine equations are derived and applied
 |
| 1. Understand impulse steam turbines
 | * 1. ***Principles of operations*** of the impulse steam turbines is described
	2. Impulse steam turbine equation is derived and applied
 |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** ***May include but not limited to:*** |
| Utilities May include but not limited to: | * + Boilers
	+ Condensers
	+ Compressors
	+ Nozzles
	+ Throttling processes
 |
| Perfect gas laws May include but not limited to: | * + Boyle’s law
	+ Charles law
	+ Gay Lussac law
 |
| Principles May include but not limited to: | * + Newton’s laws of motion
	+ Law of conservation of linear momentum
	+ Law of conservation of energy
	+ Archimedes’ principle
 |
| Types of air compressors May include but not limited to: | * + Reciprocating
	+ Blowers
	+ Sliding valves
	+ Screw
 |
| Types of Turbines May include but not limited to: | * + Compounding
	+ Multistage impulse turbine
 |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Apply basic mechanical formulas
* Use of basic mechanical machines
* Perform various unit conversions of mechanical quantities
* Basic Thermodynamics system design
* Mechanical machine operation
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Metrology

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Newton’s law
* Levers
* Gear trains
* Laws of conservation of energy
* Laws of friction
* Type of forces
* Thermodynamics
* Calculation of fluid pressure and flow rate
* Mechanical advantage and efficiency calculations
* Gas laws
* SI units of mechanical energy.
* Power transmission systems
* Parameters of fluid system
* Operation of mechanical machines
* Mechanical calculation of power, energy, work done, torque and safety factor
* Units of measurement, conversions and abbreviations

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency
 | Assessment requires evidence that the candidate: * + Identified Principlesof mechanical science
	+ Performed mechanical calculations of a system
	+ Identified types of forces on a system
	+ Identified application of forces on the production flow
	+ Tested mechanical properties of a materials
	+ Identified tools and equipment for measuring system parameters
	+ Recorded and interpreted measured parameters.
	+ Operated Thermodynamics systems
 |
| 1. Resource Implications
 | The following resources should be provided: * + Mechanical Engineering Laboratory and workshop
	+ Access to relevant workplace or appropriately simulated environment where assessment can take place
	+ Measuring tools and equipment
	+ Sample materials to be tested
 |
| 1. Methods of Assessment
 | Competency in this unit may be assessed through: * + Direct Observation
	+ Demonstration with Oral Questioning
	+ Case studies
	+ Written tests
	+ Projects
 |
| 1. Context of Assessment
 | Competency may be assessed individually in the actual workplace orthrough accredited institution  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# APPLY ELECTRICAL PRINCIPLES

**UNIT CODE:** ENG/OS/MAR/CC/04/6/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of Electrical principles skills in their work; use the concept of basic Electrical quantities, use the concepts of D.C and A.C circuits in electrical installation, use of basic electrical machine, use of power factor in electrical installation, use of earthing in Electrical installations, use of earthing in Electrical installations and apply lightning protection measures

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Use the concept of basic Electrical quantities
 | * 1. Basic ***SI unit***s in Electrical are identified
	2. ***Quantitie***s of Charge, force, work and power are identified
	3. Perform calculations involving Ohm’s law i.e. Current, Resistance and voltage
	4. Calculations involving various electrical quantities are performed
 |
| 1. Use the concepts of D.C and A.C circuits in electrical installation
 | * 1. DC and AC power principles are discussed
	2. Power factor and its importance is discussed
	3. Power factor correction is discussed
	4. Calculations involving parallel and series circuits are performed
	5. Calculations involving DC and AC Network are performed (time domain and frequency domain)
	6. DC and AC circuits are designed, developed and tested.
 |
| 1. Use Two Port networks
 | * 1. Basic passive networks are performed
	2. Characteristic impedance is determined
	3. Types of transmission lines and their applications are performed
 |
| 1. Use basic electrical machines
 | * 1. Types of various electrical machines are identified
	2. Types of Circuits in different electrical machines are discussed
	3. Calculations involving single phase and three phase AC and DC Motors are performed
	4. Calculations involving single and three phase AC and DC transformers are performed
	5. Calculations involving single and three phase generators are performed
	6. Special machines are identified
	7. Calculations involving special machines are performed
	8. Common faults in Electrical Machines and their remedies are discussed
 |
| 1. Use earthing in Electrical installations
 | * 1. Earthing and its importance are discussed.
	2. Earthing types are identified
	3. Earthing points on Electrical installation are identified
	4. Calculation involved in determining the earthing type is performed
	5. Test on an earthing system is performed in line with the IEE regulations
 |
| 1. Apply electrical system protection
 | * 1. Types of faults in an electrical system are identified
	2. Components of protection systems are identified
	3. Test to be carried out in electrical protection system are established
	4. Application of electrical protection system is determined
 |
| 1. Apply Electromagnetic field Theory
 | * 1. Principle of electromagnetism is discussed
	2. Electromagnetic radiation sources are identified
	3. Detectors of Electromagnetic radiations are determined
	4. Electromagnetic waves are applied
	5. Electromagnetics Laws are Identified
	6. Behaviours and effects of Electromagnetic waves are established
	7. Energy conservation theorem is identified
	8. Electromagnetic Energy flow is determined
 |
| 1. Apply Electrodynamics
 | * 1. Electrostatics terms are identified
	2. Magnetostatics terms are identified
	3. Electrodynamics laws are identified and applied
 |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** May include but not limited to: |
| SI unit | * + Power – Watts (W)
	+ Current – Amperes (A)
	+ Resistance – Ohms(Ω)
	+ Voltage – Volts (V)
 |
| Quantities  | * + Charge
	+ Force
	+ Work
	+ Power
 |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Apply basic Electrical formulas
* Use of basic Electrical instruments
* Perform various unit conversions of Electrical quantities
* Electrical earthing
* Lightening arrestors
* Power factor correction
* logical thinking
* problem solving
* applying statistics
* drawing graphs
* Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Electrical power calculations
* Various laws in Electrical engineering
* Electrical formulas
* Power triangle
* SI units of various electrical parameters
* Earthing testing
* Lightening arrestor testing
* Selecting the correct type of electrical machines for various uses
* Types and purpose of measuring instruments
* Units of measurement and abbreviations

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency
 | Assessment requires evidence that the candidate: * + Applied the correct SI units of Electrical quantities
	+ Stated, Calculate and relates the quantities in Ohm’s law
	+ Identified the components of an earthing system
	+ Stated and apply various laws in Electrical system
	+ Differentiated between AC and DC network
	+ Applied correct formulas in the calculation of AC and DC machines
	+ Used power triangle in calculating power factor
	+ Applied various methods in power factor correction
	+ Identified types of lightening arrestors and their applications
 |
| 1. Resource Implications
 | The following resources should be provided: * + Mechanical Engineering Laboratory and workshop
	+ Access to relevant workplace or appropriately simulated environment where assessment can take place
	+ Measuring equipment
	+ Materials relevant to the proposed activity or tasks
 |
| 1. Methods of Assessment
 | Competency in this unit may be assessed through: * + Direct Observation
	+ Demonstration with Oral Questioning
	+ Written tests
	+ Projects
 |
| 1. Context of Assessment
 | Competency may be assessed individually in the actual workplace orthrough accredited institution  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# APPLY SHIP CONSTRUCTION PRINCIPLES

**UNIT CODE:** ENG/OS/MAR/CC/05/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to apply ship construction principles. It involves categorising ship types, interpreting ship drawings, identifying ship construction materials, monitoring stress effects induced on ship structures, assesing conditions of ship principle structural members, loading a ship and carrying out elementary ship yard practices

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  | **PERFORMANCE CRITERIA*****(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Categorize ship types
 | * 1. Purpose or function of the ship is identified
	2. ***Type of ship cargo*** is determined
	3. Ships are categorised based on the type of ship load and function
 |
| 1. Interpret ship drawings
 | * 1. General Arrangement Drawing is discussed
	2. Sectional Drawings are discussed
	3. Plumbing and pipe work drawings are discussed
	4. Electrical Drawings are discussed
	5. Machineries Drawings are discussed
 |
| 1. Identify ship construction materials
 | * 1. ***Types of materials*** used in ship construction are identified
	2. Properties of high tensile steel are defined
	3. Properties of Aluminium are discussed
	4. Properties of Fibre Glass are discussed
	5. Types of steel used in hull construction are identified
	6. Use of forged, rolled and cast components in hull construction is explained
 |
| 1. Monitor stress effects induced on ships
 | * 1. Correct terms to describe effects of forces exerted on ships are used
	2. Various forces acting on the vessel are analysed
	3. Stresses on various components of the hull are compared
	4. Typical weight, load, shear force curves and bending moment diagrams are sketched
 |
| 1. Assess conditions of ship principle structural members
 | * 1. ***Ship principle structural members*** are identified
	2. Functions of ship principle structural members are identified
	3. Conditions of ship principle structural members are assessed based on their functioning principles
 |
| 1. Load a ship
 | * 1. Ship’s Load Chart and load Capacity are identified
	2. Cargo plan is reviewed
	3. Loading is prepared for as per SOPs
	4. Loading is supervised based on the loading plan
 |
| 1. Carry out elementary ship yard practices
 | * 1. Ship is inspected and Work Schedule prepared
	2. Ship docking plan is prepared and applied
	3. Recovery and launching of vessels
	4. Ship hull is painted as per SOPs
	5. Ship Hull is welded as per SOPs
	6. Shore power is supplied to the ship
	7. Ship is resupplied with water and fuel
	8. Ship is cleaned as per SOPs
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range***May include but is not limited to:* |
| Type of ship cargo May include but not limited to: | * Livestock
* Containers
* Petroleum products
* Weaponry
 |
| Types of materials May include but not limited to: | * Steel
* Aluminium
* Wood
* Zinc
* Brass
 |
| Ship principle structural members May include but not limited to: | * Hull structures
* Bow and stern structures
* Fittings
* Rudders, propellers and shafts
* Superstructure
 |

**REQUIRED KNOWLEDGE**

* Elementary ship yard practices
* Ship loading
* Ship categorization
* Stress effects on ships
* Surface Preparation and painting
* Welding Technology

**SKILLS**

* Monitoring
* Interpreting
* Planning
* Communication
* Team Work
* Personnel Management
* Statistics
* Metrology

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* Categorized ship types
* Interpreted ship drawings
* Identified ship construction materials
* Monitored stress effects induced on ships
* Assessed conditions of ship principle structural members
* Demonstrated knowledge on loading a ship
* Carried out elementary ship yard practices
 |
| 1. Resource Implications
 | The following resources should be provided:* Ship’s Drawings
* Shipyard with ship
* Dry docking Facility
* Tools and Equipment
 |
| 1. Methods of Assessment
 | Competency may be assessed through:* Written text
* Interview
* Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# MONITOR AND EVALUATE SHIP STABILITY

**UNIT CODE:** ENG/OS/MAR/CC/06/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to monitor and evaluate ship stability. It involves monitoring hydrostatic data variation, demonstrating knowledge on buoyancy, applying fresh water allowance principles, applying statistical data, determining angle of loll, determining movement of a ships centre of gravity and maintaining ship stresses within permissible limits

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  | **PERFORMANCE CRITERIA*****(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Monitor hydrostatic variation
 | * 1. Principle of Hydrostatic Variation is discussed
	2. Hydrostatic variation of the vessel is checked
	3. Hydrostatic variation tests are prepared for
	4. Tools, equipment and materials required are identified and obtained
	5. Hydrostatic variation tests are carried out as per SOPs
	6. Hydrostatic variation analysis is carried out
 |
| 1. Demonstrate knowledge on ship buoyancy
 | * 1. Principle of buoyancy is discussed
	2. Factors affecting buoyancy are identified and analysed
	3. Principles related to buoyancy are applied to job tasks
	4. Apparent weight and relative density are calculated and applied
 |
| 1. Apply fresh water allowance principles
 | * 1. Vessel draft in sea water is measured
	2. Vessel draft in fresh water is measured
	3. Fresh water allowance is measured based on the difference in sea water and fresh water draft
 |
| 1. Determine angle of loll
 | * 1. Angle of loll is defined
	2. Vessel equilibrium condition is checked
	3. Causes of negative metacentric height are identified
	4. ***Corrective measures*** are identified and applied
 |
| 1. Determine movement of a ship’s centre of gravity
 | * 1. Forces affecting ship’s center of gravity are identified and analysed
	2. Effects of removing or discharging mass are identified and analysed
	3. Effects of loading or adding mass are identified and analysed
	4. Vertical and horizontal weight shifts are identified and analysed
	5. Formulae for calculating movement of ship’s center of gravity are applied
 |
| 1. Maintain ship stresses within permissible limits
 | * 1. Stresses affecting ship stability are identified
	2. Stresses affecting ship stability are analysed
	3. Stresses identified are monitored and maintained within permissible limits
 |
| 1. Apply damage control principles
 | * 1. Damage control principles are identified and discussed
	2. Damage control ***organisation*** is discussed
	3. ***Damage control tools and equipment*** are identified and used appropriately
	4. Damage control drills are performed
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range***May include but is not limited to:* |
| Corrective measures May include but not limited to: | * Lowering center of gravity
* Minimising free surfaces
* Ballast tanks
* Flooding and Counter flooding
* Balancing of loads
 |
| Organisation May include but not limited to: | * Shoring party
* Leak stop party
* Flooding and counter flooding party
* Containment party
* First aid party
 |
| Damage control tools and equipment May include but not limited to: | * Splinter box
* Wedges
* Mallet
* Axe
* Cement
* Horse clips
* Flexible hose
* Shore
 |

**REQUIRED KNOWLEDGE**

* Naval architecture
* Hydrostatics
* Statistics
* Ship stresses
* Engineering mathematics
* Ship buoyancy
* Materials Engineering
* Technical Drawing
* Welding Technology
* Non-Destructuve Tests
* Quality Control and Quality Assurance
* OSHE

**SKILLS**

* Mathematics
* Analytical
* Statistics
* Communication
* Planning
* Coordination

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* Demonstrated ability to monitor hydrostatic variation
* Demonstrated knowledge on ship buoyancy
* Applied fresh water allowance principles
* Determined angle of loll
* Demonstrated ability to determine movement of a ship’s center of gravity
* Demonstrated ability to maintain ship stresses within permissible limits
 |
| 1. Resource Implications
 | The following resources should be provided:* Shipyard involved in ship Construction
* Active Port
* Ship Design Office
* Relevant Manuals
* Tools and Equipment
 |
| 1. Methods of Assessment
 | Competency may be assessed through:* Written text
* Interview
* Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# APPLY ENGINEERING MATHEMATICS

**UNIT CODE:** ENG/OS/MAR/CC/07/6/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a Marine Engineering technician to apply a wide range of engineering mathematics in their work. This includes: applying algebraic functions, trigonometry and hyperbolic functions, complex numbers, coordinate geometry, carrying out binomial expansion, calculus, ordinary differential equations, Laplace transforms, power series, Statistics, Fourier series, Vector theory, Matrix, Numerical methods, probability, commercial calculations, estimations, measurements and calculations of quantities in solving problems.

|  |  |
| --- | --- |
| **ELEMENTS AND PERFORMANCE CRITERIAELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| * 1. Apply Algebra
 | 1. Calculations involving Indices are performed as per the concept
2. Calculations involving Logarithms are performed as per the concept
3. Scientific calculator is used in solving mathematical problems in line with manufacturer’s manual
4. Simultaneous equations are performed as per the rules
5. Quadratic equations are calculated as per the concept
6. Arithmetic and geometric progression problems are solved
 |
| * 1. Apply Trigonometry and hyperbolic functions
 | 1. Calculations are performed using trigonometric rules
2. Calculations are performed using ***hyperbolic functions***
 |
| * 1. Apply complex numbers
 | * 1. Complex numbers are represented using Argand diagrams
	2. Operations involving complex numbers are performed
	3. Calculations involving complex numbers are performed using De Moivre’s theorem
 |
| 1. Apply Coordinate Geometry
 | * 1. Polar equations are calculated using coordinate geometry
	2. Graphs of given polar equations are drawn using the Cartesian plane
	3. Normal and tangents are determined using coordinate geometry
	4. Loci of points are determined for given mechanism
 |
| 1. Carry out Binomial Expansion
 | * 1. Roots of numbers are determined using binomial theorem
	2. Errors of small changes are determined using binomial theorem
	3. Power series are derived through Binomial expansion
 |
| 1. Apply Calculus
 | * 1. Derivatives of functions are determined using Differentiation
	2. Derivatives of hyperbolic functions are determined using Differentiation
	3. Derivatives of inverse trigonometric functions are determined using Differentiation
	4. Rate of change and small change are determined using Differentiation.
	5. Calculation involving stationery points of functions of two variables are performed using differentiation.
	6. Integrals of algebraic functions are determined using integration
	7. Integrals of trigonometric functions are determined using integration
	8. Integrals of logarithmic functions are determined using integration
	9. Integrals of hyperbolic and inverse functions are determined using integration
 |
| 1. Solve Ordinary differential equations
 | * 1. First order and second order differential equations are formed.
	2. First order and second order differential equations are solved using the method of undetermined coefficients
	3. First order and second order differential equations are solved from given boundary conditions
 |
| 1. Apply Laplace transforms
 | * 1. Laplace transforms are solved using initial and final value theorems
	2. Inverse Laplace transforms are solved using partial fractions
	3. Differential equations are solved using Laplace transforms
 |
| 1. Apply Power Series
 | * 1. Power series are obtained using Taylor’s Theorem
	2. Power series are obtained using Maclaurin’s theorem
 |
| 1. Apply Statistics
 | 1. Identification, Collection and Organization of data is performed
2. Interpretation, analysis and presentation of data in appropriate format is performed
3. Mean, median, mode and Standard deviation are obtained from given data
 |
| 1. Apply Fourier Series
 | * 1. Fourier series coefficients are obtained using Fourier series techniques
	2. Fourier series for 2π to T is are obtained using Fourier series techniques
	3. Fourier series for odd and even functions are obtained using Fourier series techniques
	4. Harmonic analysis is performed using numerical methods
 |
| 12.Apply Vector theory | * 1. Calculations involving vector algebra, dot and cross products using vector theory
	2. Gradient, Divergence and Curl are obtained
	3. Vector calculations are performed using Green’s theorem
	4. Vector calculations are performed using Stoke’s theorem
	5. Conservative vector fields and line and surface integrals are obtained using Gauss’s theorem
 |
| 1. Apply Matrix
 | * 1. Determinant and inverse of 3x3 matrix are obtained
	2. Solutions of simultaneous equations are obtained
	3. Calculation involving Eigen values and Eigen vectors are performed
 |
| 1. Apply Numerical methods
 | * 1. Roots of polynomials are obtained using iterative numerical methods
	2. Interpolation and extrapolation are performed using numerical methods
 |
| 1. Apply concepts of probability for work
 | * 1. Calculations are performed based on Laws of probability
	2. Calculation involving probability distributions, mathematical expectation sampling distributions are performed
	3. Probability events are determined from dependent, independent and mutually exclusive
	4. Counting is done using permutation, combination, tree diagrams and Venn diagrams techniques
 |
| 1. Perform commercial calculations
 | * 1. Exchange rate calculations are done using devaluation and revaluation
	2. Sales, stock turnover and profit and loss are determined
	3. Incomes, salaries and wages are calculated
 |
| 1. Perform estimations, measurements and calculations of quantities
 | * 1. Measurement information in workplace is extracted and interpreted
	2. Appropriate workplace measuring tools and equipment are identified and selected
	3. Conversions are performed between units of measurement
	4. Measurements are estimated and taken
	5. Length, width, height, perimeter, area and angles of ***figures*** are calculated
	6. Volume and surface area of figures are calculated
	7. Information is recorded using mathematical language and symbols appropriate for the task
 |

 **RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range**  |
| Hyperbolic functions includ but not limited to: | * + Sinh x
	+ Cosh x
	+ Cosec x
	+ Coth x
	+ Tanh x
	+ Sech x
 |
| Figures includes but not limited: | * + Triangles
	+ Squares
	+ Rectangles
	+ Circles
	+ Spheres
	+ Cylinders
	+ Cubes
	+ Polygons
	+ Cuboids
	+ Pyramids
 |
| Quantities includes but not limited to: | * + Weight,
	+ Mass
	+ Area
	+ Volume
	+ Length
	+ Width
	+ Depth
	+ Perimeter
 |

**REQUIRED SKILLS AND KNOWLEDGE**

 This section describes the skills and knowledge required for this unit of competency.

 **Required Skills**

 The individual needs to demonstrate the following skills:

* Applying fundamental operations (addition, subtraction, division, multiplication)
* Using and applying mathematical formulas
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Fundamental operations (addition, subtraction, division, multiplication)
* Calculating area and volume
* Types and purpose of measuring instruments
* Units of measurement and abbreviations
* Rounding techniques
* Types of fractions
* Types of tables and graphs
* Presentation of data in tables and graphs
* Vector operations
* Matrix operations

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills, knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate: * 1. Applied Trigonometry and hyperbolic functions
	2. Applied complex numbers
	3. Determined angles and length in triangles
	4. Applied Calculus
	5. Solved Ordinary differential equations
	6. Applied Laplace transforms
	7. Applied Power Series
	8. Applied Fourier Series
	9. Applied Vector theory
	10. Applied Matrix

1.11 Identified and selected measuring equipment 1.12 Collected, Analyzed and presented data1.13 Applied Numerical methods |
| 1. Resource Implications
 | The following resources should be provided: * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place
	2. Measuring equipment
	3. Materials relevant to the proposed activity or tasks
 |
| 1. Methods of Assessment
 | Competency in this unit may be assessed through: * 1. Direct Observation
	2. Demonstration with Oral Questioning
	3. Written tests
 |
| Context of Assessment | Competency may be assessed individually in the actual workplace orthrough accredited institution  |
| Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# DEMONSTRATE BASIC SEA SURVIVAL SKILLS

**UNIT CODE:** ENG/OS/MAR/CC/08/6/A

**UNIT DESCRIPTION**

This unit covers the competencies required to effectively demonstrate basic sea survival skills. It entails identifying and being able to utilize lifesaving equipment such as life boat, life jacket, and emergency communication devices such as EPIRB, SART, and being able to swim a minimum of 25 metres.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| 1. Apply first aid techniques
 | * 1. ABCs of first aid are described
	2. CPR process is described and demonstrated
	3. Basic first aid procedures are described and demonstrated
 |
| 1. Demonstrate ability to swim
 | * 1. Swimming strokes are demonstrated
	2. Ability to tread water is demonstrated
 |
| 1. Understand the SOLAS Convention
 | * 1. Role and signatories of SOLAS are identified
	2. Provisions of SOLAS are identified
	3. International Ship and Port Facility Security (ISPS) code is described and understood
	4. Maritime Security (MARSEC) levels are identified
	5. International Life Saving Appliance Code (LSA) is described and understood
 |
| 1. Identify lifesaving equipment
 | * 1. ***Lifesaving equipment*** are described and identified
	2. Contents of life saving crafts are described and identified
 |
| 1. Identify emergency signaling devices
 | * 1. ***Emergency signalling devices***are described
	2. Emergency signalling devices are identified
 |
| 1. Use lifesaving and emergency signaling equipment
 | * 1. Lifesaving equipment are worn properly
	2. Ability to swim 25 metres in lifesaving equipment is demonstrated
	3. Proper use of emergency signalling equipment is demonstrated
 |
| 1. Apply proper storage and maintenance of life saving equipment
 | * 1. Level 1 checks on life saving equipment are demonstrated.
	2. Maintenance on life saving equipment is identified
 |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| ABCs May include but not limited to: | * Airway
* Breathing
* Circulation
 |
| Lifesaving equipment may include but is not limited to | * Lifebuoy
* Lifejacket
* Immersion suit
* Anti-exposure suit
* Thermal protective aids
 |
| Emergency signaling equipment may include but not limited to: | * Emergency Position Indicating Radio Beacon (EPIRB)
* Search and Rescue Transponders (SART)
* Rocket parachute flares
* Hand flares
* Buoyant smoke signal
* Signalling mirror
 |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Observation
* Communication
* Swimming
* Time management
* Decision making
* Planning
* Multitasking
* First aid
* Team Work
* OSHE

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* SOLAS manual
* ISPS Code
* Types of alarm
* Lifesaving equipment
* Emergency signalling equipment

EVIDENCE GUIDE

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:* + Applied basic first aid techniques in response to an emergency
	+ Applied breast, back, side stroke and free style swimming techniques for 25m each
	+ Treaded water for a minimum of 5 minutes unassisted
	+ Identified the need for the SOLAS convention
	+ Identified and applied the ISPS levels
	+ Identified muster point
	+ Identified general alarm and fire alarm
	+ Identified and correctly wore lifesaving equipment
	+ Demonstrated how to use emergency signalling equipment
	+ Demonstrated proper stowage of lifesaving equipment
 |
| 1. Resource Implications
 | * + Swimming pool
	+ Swimming instructor
	+ SOLAS, ISPS, LSA Manuals
	+ Lifesaving equipment
	+ Emergency signalling equipment
 |
| 1. Methods of Assessment
 | Competency may be assessed through:* + Written Test
	+ Demonstration
	+ Practical assignment
	+ Interview/Oral Questioning
	+ Demonstration
 |
| 1. Context of Assessment
 | Competency may be assessed in an off and on the job setting |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# CORE COMPETENCIES

# SURVEY HULL AND SUPERSTRUCTURE OF A VESSEL

**UNIT CODE:** ENG/OS/MAR/CR/01/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to survey hull and superstructure of a vessel. It involves idenitfying deck numbering, compartments and location markings, planning and preparing for survey tasks, identifying hull type and material construction, conducting periodic survey of hull and superstructure and assessing non-compliance

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| --- | --- |
| 1. Identify deck numbering and location markings
 | * 1. Ship layout is obtained in line with workplace policy
	2. Ship layout is analysed as per SOPs
	3. Deck numbering and location markings are identified based on the ship layout
 |
| 1. Plan and prepare for survey task
 | * 1. Survey purpose, objectives and variations are identified and discussed with relevant personnel
	2. Relevant standards for vessel hull and superstructure are identified and accessed to support survey task
	3. Vessel hull and Superstructure material is identified.
	4. ***Vessel survey method*** is identified and relevant regulatory requirements, organisational requirements and procedures for survey scope are reviewed
	5. Vessel survey method is confirmed against regulatory and organisational requirements as per SOPs
	6. Operational limits, certificates of operations and previous certificates of survey are reviewed as per SOPs (Standard Operating Procedures)
	7. Survey tools and equipment are identified, selected and checked as per SOPs
	8. Detailed Survey Report Template is prepared as per SOPs.
 |
| 1. Identify hull type and construction materials
 | * 1. ***Types of hull*** common to vessels are identified as per SOPs
	2. Materials used in hull construction and superstructure are identified as per SOPs
	3. Regulatory/additional standards are reviewed for use in survey as per SOPs
 |
| 1. Conduct periodic survey of hull and superstructure
 | * 1. Survey of hull and superstructure is carried out according to regulatory requirements
	2. Changes to operational equipment or equivalent solutions are identified and examined as required by survey schedule
	3. Watertight openings and skin fittings are inspected for compliance as per SOPs
	4. Paint and coatings are inspected for condition as per SOPs
	5. ***Cathodic protection*** is inspected where applicable as per SOPs
	6. Superstructure weather tightness is inspected as per SOPs
	7. Appendages are inspected as per SOPs
	8. Detailed Periodic Inspection Log is updated and recommendations made as per SOPs.
 |
| 1. Assess non-compliance and remedies
 | * 1. Non-compliance is detected, recorded and reported according to regulatory and organisational requirements
	2. Specialist support services are identified and sourced as per SOPs
	3. Risks from detected non-compliance are reported and communicated as per SOPs
	4. Relevant provisions of legislation appropriate to level of risk detected are identified and followed as per SOPs
	5. Non-compliance assessment reports are prepared and managed according to organisational and regulatory requirements
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range***May include but is not limited to:* |
| Vessel survey types | * Initial Acceptance Survey
* Periodic Survey
* Condition Monitoring Survey
* Post Maintenance Survey
* Breakdown Survey
 |
| Vessel survey methods | * Ultrasonic
* X-Ray
* Dye penetrant inspection test (DPT)
* Magnetic particle inspection (MPI)
* Dimension measurement
 |
| Types of hulls | * Displacement
* Planning
 |
| Cathodic protection | * Sacrificial protection
* Galvanic protection
 |

**REQUIRED KNOWLEDGE**

* Marine survey
* Vessel survey methods
* Ship construction techniques
* Deck numbering and location markings
* Metrology
* International Maritime Organisation Standards

**SKILLS**

* Planning
* Organisation
* Surveying
* Coordinating
* Communication
* Analytical
* Digital
* Critical thinking
* Problem solving
* Decision making
* Reporting
* Teamwork and Personnel Management
* Attention to detail

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Identified deck numbering and location markings
	+ Demonstrated ability to plan and prepare for survey task
	+ Identified hull type and material construction
	+ Conducted periodic survey of hull and superstructure
	+ Demonstrated ability to assess non-compliance
	+ Demonstrated ability to collect and analyse survey and test data.
	+ Demonstrated ability to use survey tools and equipment.
	+ Demonstrated ability to draw sketch of Ship’s GA-General Arrangement.
 |
| 1. Resource Implications
 | The following resources should be provided:* + Hull Survey manuals
	+ Hull Survey Tools and Equipment
	+ Detailed Architectural Drawings of the ship
	+ Stationery
	+ Trained personnel
	+ Vessel or hull simulator
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Interview
3. Assignment and Completion of tasks
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# SURVEY VESSEL OPERATIONAL SYSTEMS

**UNIT CODE:** ENG/OS/MAR/CR/02/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to identify ship operational systems, idenitifying survey requirements, preparing for survey, conducting periodic survey of operational systems and assessing non-compliance

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Identify ship operational systems
 | * 1. ***Main operational systems*** are identified as per SOPs
	2. ***Auxiliary operational systems*** are identified as per SOPs
 |
| 1. Identify survey requirements
 | * 1. ***Objectives of the survey*** are identified and defined.
	2. Standards for vessel equipment and operational systems are identified and incorporated into survey plan as per SOPs
	3. Survey scope and depth is established as per organisation requirements
	4. Operational limits, certificate of operations and previous certificates of survey are reviewed as per SOPs
	5. Equipment and operational system requirements for survey and range of variations are identified, reviewed and incorporated into survey plan as per SOPs
	6. Survey Plan is formulated
 |
| 1. Prepare for survey
 | * 1. Operational systems to be surveyed are identified, reviewed and incorporated to survey plan as per SOPs and survey plan is formed.
	2. Relationships between different operational systems are interpreted and items to be surveyed noted as per SOPs
	3. Maintenance records are obtained and reviewed as per organisation policy
 |
| 1. Conduct survey of operational systems
 | * 1. Survey of operational systems is carried out according to regulatory requirements
	2. Main and auxiliary operational systems and their components are surveyed according to the survey schedule
	3. Detailed survey report is written as per SOPs
	4. Changes to operational equipment or equivalent solutions are identified and examined as required by survey schedule
 |
| 1. Assess non-compliance and remedies
 | * 1. Non-compliance Criteria is defined as per SOPs.
	2. Non-compliance is detected, recorded and reported according to regulatory and organisational requirements
	3. Risks from detected non-compliance are reported and communicated as per SOPs
	4. Relevant provisions of legislation appropriate to level of risk detected are identified and followed as per SOPs
	5. Non-compliance assessment reports are prepared and managed according to organisational and regulatory requirements
	6. Specialist support services (Third Party Survey) are identified and sourced as per SOPs
	7. Third Party Report is analysed together with the organization’s report.
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Objectives of survey May include but not limited to: | * Periodic
* Preventive
* Breakdown
* Initial acceptance
* Condition based monitoring
 |
| Main operational systems May include but not limited to: | * Main engines
* Gearbox
* Engine oil coolers
* Heat exchangers
* Separators
* Air coolers
* Preheat systems
* Gas turbines
* Propeller and shafts
 |
| Auxiliary operational systems May include but not limited to: | * Generators
* Steering system
* Stabilizers
* Reverse Osmosis Plant
* Sewage treatment plant
* Firefighting system
* Air conditioning units
* Refrigeration
* Bow thrust system
* Slow Speed Drive (SSD)
 |

**REQUIRED KNOWLEDGE**

* Ship operational systems
* Ship survey
* Regulatory requirements
* Non-Compliance Criteria
* Condition Monitoring
* Metrology
* IMO Standards

**SKILLS**

* Planning
* Surveying
* Coordinating
* Communication
* Analytical
* Digital
* Critical thinking
* Problem solving
* Decision making
* Reporting
* Teamwork and Personnel Management

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Identified ship operational systems and their functions
	+ Identified and defined survey Objectives
	+ Identified survey requirements
	+ Prepared for survey
	+ Conducted periodic survey of operational systems
	+ Prepared Detailed Survey Report
	+ Defined and Understood Non-Compliance Criteria
	+ Demonstrated ability to assess non-compliance
 |
| 1. Resource Implications
 | The following resources should be provided:* + Stationery
	+ Trained personnel
	+ Survey Tools and Equipment
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Interview
3. Assignment and Completion of Tasks
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

# PREPARE AND INTERPRET ENGINEERING DRAWINGS

**UNIT CODE:** ENG/OS/MAR/CR/03/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to prepare and interpret engineering drawings. It involves preparing cam followers and profile drawings, sketching and labelling screw threads, identifying machine bearings, drawing gear profiles, interpreting limits and fits, interpreting palnt layout design, electrical plans and diagrams, applying computer aided design packages and producing 3D drawings and animation

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Prepare cam followers and profile drawings
 | * 1. Basic curves are prepared
	2. Modified Cam Curves are prepared
	3. Polynomial and Fourier Series Curves are prepared
	4. Cam Motion synthesis using spline Functions is interpreted
	5. Elements of Cam Profile Geometry are identified
	6. Geometry of planer cam followers is interpreted
	7. Cam Mechanism Forces are identified
	8. Cam Materials and lubrication is interpreted
	9. Cam Manufacturing is interpreted
	10. Cam system Modelling is interpreted
	11. Cam System Dynamics is analysed
	12. Special Cam Mechanisms are identified
	13. CAD for Cams is understood
	14. Free hand Sketching of cams
	15. Technical Drawing of Cams is interpreted
 |
| 1. Sketch and label screw threads
 | * 1. Various types of screw threads are identified.
	2. Parts of screws are identified.
	3. Equipment used to measure screw thread are identified.
	4. Dimensions of the screw are identified
	5. Free hand sketch of the screw is drawn.
	6. The Sketch dimensions are labelled.
 |
| 1. Identify machine bearings
 | * 1. Various types of bearings are identified
	2. Bearing codes are interpreted
	3. Various operation conditions of different bearing types are identified.
 |
| 1. Draw gear profiles
 | * 1. Various types of gears are identified
	2. Gear nomenclature is identified
	3. Dimensions of the gear are identified
	4. Free hand sketch of the gear is made.
	5. Projection and scale to be used are identified
	6. Gear sketch is drawn either using CAD or on a drawing paper
 |
| 1. Interpret limits and fits
 | * 1. Importance of limit and fits in design is identified
	2. Machine components that apply limits and fits are identified
	3. Terminologies used in Limits and fits are defined
	4. Calculations involving limits and fits are identified and solved.
	5. Limits and fits table from Manufacturer is interpreted
 |
| 1. Interpret marine plant layout design
 | * 1. Different types of plants are identified
	2. Purpose of each plant is identified
	3. Symbols for different machines are identified
	4. Schematic diagram for plant layout is interpreted.
 |
| 1. Prepare and interpret electrical drawing
 | * 1. Various electrical plants, components and modules are identified
	2. Electrical symbols representing plants, components and modules are identified
	3. ***Electrical drawings*** are prepared
 |
| 1. Apply computer aided design packages
 | * 1. Type of design to be done is identified
	2. Free hand sketch of what is to be designed is prepared
	3. Scale to be used is identified
	4. Type of Projection to be used is identified
	5. CAD Package to be used is identified
	6. CAD Package identified is used appropriately for design.
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range***May include but is not limited to:* |
| Electrical drawings May include but not limited to: | * Electrical plans
* Electrical diagrams
	+ One-line diagram
	+ Panel wiring diagram
	+ Instrument wiring diagram
	+ Interconnection diagram
	+ Ladder diagram
 |

**REQUIRED KNOWLEDGE**

* Free hand sketching
* Technical Drawing and Design
* Computer Aided Design
* Interpretation of Engineering Drawings

**SKILLS**

* Planning
* Surveying
* Coordinating
* Communication
* Analytical
* Digital
* Critical thinking
* Problem solving
* Decision making
* Reporting
* Teamwork and Personnel Management

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Prepared cam followers and profile drawings
	+ Sketched and labelled screw threads
	+ Identified machine bearings
	+ Drew gear profiles
	+ Interpreted limits and fits and plant layout designs
	+ Applied computer aided design packages
	+ Produced 3D drawings and animations
 |
| 1. Resource Implications
 | The following resources should be provided:* + Drawing papers
	+ Drawing tables
	+ Drawing studio
	+ Drawing tools and Equipment
	+ AutoCAD Software
	+ Computers
	+ Solid Works Software
	+ Animation software
	+ Stationery
	+ Trained personnel
	+ Machinery and components
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Interview
3. Assignment and completion of tasks
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# INSTALL AND MAINTAIN MARINE PUMPS

**UNIT CODE:** ENG/OS/MAR/CR/04/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to install and maintain marine pumps. It involves identifying constructional features and operating principles of pumps and pump types, installing marine pumps, diagnosing marine pump faults, maintaining marine pumps, preparing spare parts list and special maintenance tools, preparing work schedules and preparing work reports

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Identify constructional features and operating principles of pumps and pump types
 | * 1. Different ***types of pumps*** are reviewed from manufacturer’s manuals as per SOPs
	2. Operating principles and theories of different types of pumps are identified and applied in line with manufacturer’s specifications
	3. Functions of major components of pumps are identified from manufacturer’s manuals
	4. Pump specifications are interpreted as per SOPs
	5. Functions of drive components are identified form manufacturer’s manuals
	6. Functions of each pump in a ship’s system are identified.
 |
| 1. Install marine pumps
 | * 1. Location and head for installation is determined according to engineering drawings
	2. Base for pump is cleaned
	3. Pump Mounting is prepared according to engineering drawings
	4. Pump components are installed in line with standard procedures
	5. Pump is positioned, levelled, aligned and secured in line with standard procedures
	6. The installed pump is tested according to Manufacturer’s manual.
 |
| 1. Diagnose marine pump faults
 | * 1. Inspection of components is performed in accordance with manufacturer’s specifications and workplace procedures and the pump’s behaviour recorded.
	2. Information on the description and symptoms of the problem is obtained and analysed in line with workplace procedures
	3. Inspection report is linked with Manufacturer’s Maintenance and Repair Manual to ease troubleshooting.
	4. Condition based monitoring routine procedures are performed as per SOPs
	5. Conditions that lead to failure or breakdown of pumps are identified in line with workplace procedures
	6. Diagnosis and Condition monitoring Report is made as per Manufacturer’s manual.
 |
| 1. Maintain marine pumps
 | * 1. Maintenance requirements and plans are verified according to manufacturer’s specifications
	2. Defective pump Components are identified and demanded from Stores according to organization’s SOPs
	3. Defective pump components are replaced/serviced according to manufacturer’s specifications
	4. Fluid levels are checked and maintained in accordance with specifications
	5. Suction and delivery pipe lines are inspected as per SOPs
	6. Temperatures, vacuum, pressure, vibrations , leakages and flow rates are checked and maintained in accordance with specifications
	7. Maintenance reports are prepared and maintained as per workplace policy and SOPs
 |
| 1. Prepare spare parts list and special maintenance tools
 | * 1. Spare parts are identified and noted based on faulty pump parts to be replaced
	2. Special maintenance tools are identified based on manufacturer’s manuals
	3. Spare parts list and special maintenance tools are prepared in line with workplace policy
	4. Spare parts acquisition procedures are carried out
 |
| 1. Prepare work schedule and methodology
 | * 1. Maintenance activities are identified based on the scope of maintenance
	2. Maintenance/work schedule is prepared based on maintenance activities identified
	3. Work methodology is prepared as per SOPs
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range***May include but is not limited to:* |
| Types of pumps May include but not limited to: | * Reciprocating piston pump
* Gear pumps
* Screw pump
* Centrifugal pump
* Diaphragm pump
 |

**REQUIRED KNOWLEDGE**

* Cooling and lubrication systems
* Pump drive components
* Conditon-based monitoring technologies
* Condition-based monitoring tools
* Prime movers
* Fault diagnosis
* Pumping and tubing sizing and schematics

**SKILLS**

* Communication
* Problem solving
* Planning
* Organisation
* Technological
* Surveying
* Coordinating
* Analytical
* Critical thinking
* Decision making
* Reporting
* Teamwork and Personnel Management

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Identified constructional features and operating principles of pumps and type of pumps
	+ Installed marine pumps
	+ Demonstrated ability to diagnose marine pump faults
	+ Demonstrated ability to maintain marine pumps
	+ Prepared spare parts list and special maintenance tools
	+ Prepared work schedule
 |
| 1. Resource Implications
 | The following resources should be provided:* + Pump Survey and Maintenance manuals
	+ Pump Inspection and Maintenance Tools
	+ Detailed pump engineering drawings and parts list
	+ Trained personnel
	+ Stationery
	+ Pumps
	+ Sectioned pumps
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Interview
3. Assignment and Completion of tasks
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# INSTALL AND MAINTAIN AIR COMPRESSORS

**UNIT CODE:** ENG/OS/MAR/CR/05/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to install and maintain air compressors. It involves identifying operating principles of air compressors, identifying common failures of air compressors and remedies, identifying air compressor maintenance procedures, preparing spare parts list and special maintenance tools, installing air compressors, preparing work schedule and preparing work reports

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Identify operating principles of air compressors
 | * 1. Different ***types of compressors*** are reviewed
	2. Operating principles and theories of different types of compressors are identified and applied in line with manufacturer’s specifications
	3. Operation Instructions are identified as per Manufacturer’s operation Manual
	4. Functions of major components of compressors are identified from manufacturer’s manuals
	5. Condition-Monitoring parameters and limits are identified
	6. Compressor specifications are interpreted as per SOPs
 |
| 1. Identify air compressor maintenance procedures
 | * 1. Common faults of air compressors and their remedies are reviewed from manufacturer’s (O & M) Operation and Maintenance manuals as per SOPs
	2. Maintenance procedures for common faults are reviewed from manufacturer’s manuals as per SOPs
	3. Maintenance procedures are carried out in line with manufacturer’s specifications.
	4. Maintenance and Condition-Monitoring Reports are prepared.
 |
| 1. Prepare spare parts list and special maintenance tools
 | * 1. Spare parts are identified and noted based on faulty air compressor parts to be replaced
	2. Special maintenance tools are identified based on manufacturer’s manuals.
	3. ***Spare parts and consumables*** are classified as either running spares or breakdown spares.
	4. Spares and tools are demanded as per organization’s SOPs.
	5. Spare parts list and special maintenance tools are prepared in line with workplace policy
 |
| 1. Install and operate air compressors
 | * 1. Location and elevation for installation are determined according to engineering drawings
	2. Tools, equipment and materials are selected in line with job requirements
	3. Required pressure and plant demand are confirmed according to engineered drawings
	4. Compressor mounting is prepared according to engineering drawings
	5. Compressor is installed in position.
	6. Delivery and suction pipes are connected in line with manufacturer’s specifications
	7. ***Compressor accessories*** are installed in line with manufacturer’s specifications
	8. Installed compressors are test-run and monitored for acceptance as per SOPs
 |
| 1. Prepare work schedule and methodology
 | * 1. Maintenance activities are identified based on the scope of maintenance
	2. Work Methodology is stated as per SOPs
	3. Maintenance/work schedule is prepared based on maintenance activities identified
 |
| 1. Prepare work reports
 | * 1. Maintenance is carried out as per manufacturer’s specifications
	2. Maintenance reports are prepared and maintained in line with workplace policy
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Types of compressors May include but not limited to: | * Centrifugal
* Reciprocating
* Rotary screw
* Rotary vane
 |
| Spare parts and consumables May include but not limited to: | * Running spares and consumables
	+ Air filters
	+ Air dryers
	+ Compressor oil
* Breakdown spares and consumables
	+ O-Rings and seals
	+ Pressure gauges
	+ Valves
	+ Moving/rotating parts
	+ Sensors and solenoids
 |
| Compressor accessories May include but not limited to: | * Silencers
* Filters
* Air dryers
* Lubricators
* Scrubbers
* Air Receivers
* Valves
* Limit switches
* Electronic Control and Monitoring Units
* Pulleys
* Drive Belts
* Prime mover
 |

**REQUIRED KNOWLEDGE**

* Compressor components
* Compressor accessories
* Compressor faults
* Compressor specifications
* Drive components (coupling and belts)
* Working Principles of Different types of Compressors
* Operation and Maintenance procedures for different types of compressors
* Installation of Compressors
* Condition-Monitoring

**SKILLS**

* Communication
* Problem solving
* Planning
* Organising
* Technological
* Surveying
* Coordinating
* Analytical
* Digital
* Critical thinking
* Decision making
* Reporting
* Teamwork and Personnel Management

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Identified operating principles of air compressors
	+ Identified air compressor maintenance procedures
	+ Prepared spare parts list and special maintenance tools
	+ Installed air compressors
	+ Prepared work schedule
	+ Prepared work reports
	+ Prepared Work Methodology
 |
| 1. Resource Implications
 | The following resources should be provided:* + Compressors Operation and Maintenance Manuals
	+ Previous maintenance Records (for used Compressors)
	+ Maintenance Tools and Equipment
	+ Spare parts.
	+ Stationery
	+ Trained personnel
	+ Compressors
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Interview
3. Assignment and Completion of tasks
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# PERFORM MARINE ENGINE WORKS

**UNIT CODE:** ENG/OS/MAR/CR/06/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to perform marine engine works. It involves identifying operating principles of engines, identifying common failures of engines and remedies, carrying out engine maintenance and repair, performing engine overhaul, preparing work schedule/maintenance plan and preparing work reports.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Identify operating principles, common faults and remedies of engines
 | * 1. Different ***types of engines*** are reviewed from manufacturer’s manuals as per SOPs
	2. Operating principles and theories of different types of engines are identified and applied in line with manufacturer’s specifications
	3. Functions of major ***components of engines*** are identified from manufacturer’s manuals
	4. Engine specifications are interpreted as per SOPs
	5. Common engine failures and their remedies are reviewed and analysed based on manufacturer’s specifications
	6. Condition-monitoring parameters and their limits are identified.
 |
| 1. Carry out engine maintenance and repair
 | * 1. Engine mechanical and operational conditions are assessed as per SOPs
	2. Diagnostic tests are carried out in line with SOPs
	3. Lubrication, fuel and cooling systems are serviced according to manufacturer’s specifications
	4. Fluids and lubricants are replenished according to manufacturer’s specifications
	5. Tools and equipment required for Engine overhaul are identified and prepared.
	6. Maintenance Methodology and Schedule are prepared.
	7. Spare parts list is prepared and spares demanded as per service or maintenance requirement.
	8. Engine parts are replaced or serviced according to manufacturer’s specifications
	9. Engine maintenance and repair reports are prepared as per workplace policy
	10. Engine is test-run as per SOPs
 |
| 1. Perform engine overhaul
 | * 1. ***Overhaul type*** is identified as per running hours.
	2. Overhaul kit is prepared according to the type of overhaul.
	3. Tools and equipment required for engine overhaul are prepared
	4. Engine camshaft is replaced or serviced according to manufacturer’s specification and inspection report.
	5. Engine mountings are replaced according to manufacturer’s specification
	6. Engine oil seals are replaced according to manufacturer’s specification
	7. Engine oil rings/ piston gudgeon pin are replaced according to manufacturer’s specification
	8. Timing belts/chains are replaced according to manufacturer’s specification
	9. Engine bearings are replaced according to manufacturer’s specification
	10. ***Engine pulleys*** are replaced according to manufacturer’s specification
	11. Engine gaskets are replaced according to manufacturer’s specification
	12. Engine blocks are serviced according to manufacturer’s specification
	13. Water/oil pump is replaced according to manufacturer’s specification
	14. Valve seats are serviced according to manufacturer’s specification
	15. Valve guides are replaced according to manufacturer’s specification and inspection report.
	16. Oil sump/strainer/PCV is replaced according to manufacturer’s specification
	17. Engine tune up is performed according to manufacturer’s specification
	18. Tappet clearance is adjusted according to manufacturer’s specification
	19. Engine tests are carried out according to Manufacturer’s specifications.
 |
| 1. Prepare work schedule/maintenance plan and methodology
 | * 1. Maintenance activities are identified based on the scope of maintenance
	2. Maintenance methodology is prepared
	3. Maintenance/work schedule is prepared based on maintenance activities identified
 |
| 1. Prepare work reports
 | * 1. Maintenance is carried out as per manufacturer’s specifications
	2. Maintenance reports are prepared and maintained in line with workplace policy
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Overhaul type May include but not limited to: | * Top overhaul
* Major overhaul
 |
| Types of engines May include but not limited to: | * Diesel
* Gas turbines
* Gas (LPG)
* Electrical (hybrid)
* Petrol Engines
* Diesel on Electrical (DOE)
* Diesel on Gas Turbine (DOGT)
* Diesel on Diesel
 |
| Components of engines May include but not limited to: | * Piston and piston rings
* Crankshaft
* Drive pulleys
* Timing gears
* Cylinder head
* Cylinder block
* Governor
* Inbuilt pumps
* Turbo Chargers
* Catalytic Reactors
* Intake and Exhaust Manifolds
* Fuel filters
* Lubrication oil filters
* Air cleaners
* Oil coolers
* Heat exchangers
* Fuel Injectors
* Sensors and solenoids
* Breathers
* Electronic Control Unit
* Intercooler
* Valves
* Push rods
* Connecting rods
* Cylinder lining
* Cylinder gaskets
* Bearings
 |
| Engine pulleys May include but not limited to: | * V belt
* Chain and sprocket
 |

**REQUIRED KNOWLEDGE**

* Types of engines
* Engine components
* Engine service and repair procedures
* Engine operation
* Engine drawing interpretation
* Occupational Safety and Health
* Computer knowledge
* Basic Mechatronics
* Basic Ship Automation
* Basic Chemical Polymer Engineering
* Procurement Procedures

**SKILLS**

* Communications
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* Multitasking
* First aid
* Report writing
* Team work
* Personnel Management
* Innovative

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Identified operating principles, common faults and remedies of engines
	+ Demonstrated ability to carry out engine maintenance and repair
	+ Demonstrated ability to perform engine overhaul
	+ Prepared work schedule/maintenance plan and Work Methodology.
	+ Prepared work reports
 |
| 1. Resource Implications
 | The following resources should be provided:* + Engine Operation and Maintenance Manuals
	+ Tools and Equipment
	+ Required Spares and kits
	+ Trained personnel
	+ Stationery
	+ Workshop
	+ Lifting equipment
	+ Marine engine
	+ PPE
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Interview
3. Assignment and Completion of Tasks
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# OPERATE MARINE ELECTRICAL AND ELECTRONIC SYSTEMS

**UNIT CODE:** ENG/OS/MAR/CR/07/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to operate marine electrical and electronic systems. It involves monitoring AC generator operating conditions, monitor DC power, installing and testing transformers, operating shipboard power, installing and testing 3 phase motors, installing and operating DC motors, operating and maintaining electrical protection systems, monitoring high voltage installation performance, carrying out electrical components and equipment repair, preparing spare parts list and special maintenance tools, preparing work schedule/maintenance plan and preparing work reports

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Monitor AC generator operating conditions
 | * 1. Generator starting systems are checked and rectified according to SOPs
	2. Generator mounting is checked as per SOPs
	3. Condition-monitoring parameters and their limits are identified.
	4. Lubrication systems are checked in line with manufacturer’s specifications
	5. Cooling systems are checked in line with manufacturer’s specifications
	6. Fuel systems are checked in line with manufacturer’s specifications
	7. Exhaust systems are inspected in line with manufacturer’s specifications
	8. Condition-Monitoring Reports are prepared.
 |
| 1. Monitor DC power operating conditions
 | * 1. ***DC power source*** to be monitored is identified
	2. DC power ***running parameters*** to be monitored are identified
	3. DC power is monitored for normal operation conditions in line with workplace policy
	4. Faults in operating conditions are detected as per SOPs
	5. Corrective actions are taken in accordance with workplace policy
	6. Condition-monitoring reports are prepared
 |
| 1. Install and test transformers
 | * 1. ***Transformer function*** is identified
	2. Transformer installation location is selected in line with safety codes and regulations
	3. Installation location is prepared as per SOPs
	4. Transformer is inspected before installation as per SOPs
	5. Tools, hardware and equipment for use in installation and testing are identified as per job requirements
	6. Transformer is installed and secured
	7. Transformer connections are identified and connected in line with manufacturer specifications
	8. Transformer sound levels are dampened as per SOPs
	9. Transformer is grounded as per SOPs
	10. Transformer is inspected and tested in line with manufacturer’s specifications
	11. Transformer is energized and loaded as per workplace requirements and manufacturer’s specifications
 |
| 1. Operate shipboard power distribution systems
 | * 1. Shipboard Power conditioning and distribution system is identified and characterised by source and capacity
	2. Power source synchronization system and safety systems are identified.
	3. Ship power requirements are identified based on the ***load characteristic*** of ship equipment
	4. Shipboard power distribution circuits up to final sub-circuit layout is interpreted as per SOPs
	5. Shipboard power distribution systems are operated based on ship power requirement
 |
| 1. Install and operate A.C. motors
 | * 1. A.C. Motor power and control wiring drawings are interpreted as per SOPs
	2. Installation location is identified and prepared as per SOPs
	3. Tools and equipment required are prepared.
	4. A.C. Motor is installed as per motor installation drawings
	5. A.C. Motor is tested as per manufacturer’s specifications and test reports prepared
 |
| 1. Install and operate DC motors
 | * 1. DC motor power and control wiring drawings are interpreted as per SOPs
	2. Tools and equipment required are prepared.
	3. DC motor is installed as per motor installation drawing
	4. DC motor is operated in line with manufacturer’s instructions
 |
| 1. Operate and maintain electrical protection system
 | * 1. Type of ***electrical protection system*** is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of electrical protection system
	3. Working principles of electrical protection systems are identified as per manufacturer’s manuals
	4. ***Condition-Monitoring*** parameters and their limits are identified
	5. Maintenance records are reviewed
	6. Electrical protection systems are operated in line with manufacturer’s manuals
	7. Tools and equipment required are prepared.
	8. Electrical protection systems are maintained in line with manufacturer’s instructions and workplace policy
	9. Condition-monitoring and Maintenance Reports are prepared
 |
| 1. Monitor medium voltage installation performance
 | * 1. Medium voltage installation to be monitored is identified
	2. Condition-Monitoring parameters and their limits are identified
	3. Medium voltage installation is monitored for normal operation in line with installation manuals
	4. Faults in performance are detected as per SOPs
	5. Condition-monitoring reports are prepared
 |
| 1. Carry out electrical components and equipment repair
 | * 1. Electrical components and equipment to be monitored are identified.
	2. Electrical components and equipment are inspected as per SOPs
	3. Maintenance and repair schedule is prepared as per job requirements
	4. List of materials, tools and equipment required is prepared based on repair needs
	5. Electrical components and equipment are repaired as per SOPs and manufacturer’s instructions
	6. Electrical components and equipment are tested as per SOPs
	7. Maintenance Reports are prepared.
 |
| 1. Prepare spare parts list and special maintenance tools
 | * 1. Spare parts are identified and noted based on manufacturer’s manuals
	2. Special maintenance tools are identified based on manufacturer’s manuals
	3. Spare parts list and special maintenance tools are prepared in line with workplace policy
 |
| 1. Prepare work schedule/maintenance plan and work methodology
 | * 1. Maintenance activities are identified based on the scope of maintenance
	2. Work Methodology is prepared
	3. Maintenance/work schedule is prepared based on maintenance activities identified
 |
| 1. Prepare work reports
 | * 1. Maintenance is carried out as per manufacturer’s specifications
	2. Maintenance reports are prepared and maintained in line with workplace policy
	3. Condition-Monitoring Reports are prepared.
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| DC power source may include but not limited to: | * Rechargeable batteries
* Inverter
 |
| Running parameters May include but not limited to: | * Current
* Voltage
* Resistance
* Power
 |
| Transformer function May include but not limited to: | * Step up
* Step down
 |
| Load characteristic May include but not limited to: | * Voltage
* Frequency
* KVA Rating
* Power factor
 |
| Electrical protection system May include but not limited to: | * Short circuit protection
* Overload protection
* Under and over frequency
* Phase sequence failure protection
 |
| Condition-Monitoring parameters May include but not limited to: | * Insulation
* Earth impedance
* Trip mechanism
 |

**REQUIRED KNOWLEDGE**

* AC machines
* DC machines
* Medium voltage installations
* Electrical protection systems
* Single phase and 3 phase systems
* Shipboard power distribution systems

**SKILLS**

* Communications
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* Multitasking
* First aid
* Report writing
* Team work
* Personnel Management
* Innovative
* Electronics

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Demonstrated ability to monitor AC generator operating conditions
	+ Demonstrated ability to monitor DC power operating conditions
	+ Demonstrated ability to install and test transformers
	+ Demonstrated ability to operate shipboard power distribution systems
	+ Demonstrated ability to install and test 3 phase motors
	+ Demonstrated ability to install and operate DC motors
	+ Demonstrated ability to operate and maintain electrical protection system
	+ Demonstrated ability to monitor high voltage installation performance
	+ Carried out electrical components and equipment repair
	+ Prepared spare parts list and special maintenance tools
	+ Prepared work schedule/maintenance plan
	+ Prepared work reports
 |
| 1. Resource Implications
 | The following resources should be provided:* + Electrical Systems Schematic Drawings
	+ Manufacturer’s Manuals
	+ Electrical tools, measuring devices and equipment
	+ Stationery
	+ Trained personnel
	+ AC and DC machines
	+ Sectioned electrical motors
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Assignment and Completion of tasks
3. Interview
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# OPERATE AND MAINTAIN SHIP CONTROL AND AUTOMATION SYSTEMS

**UNIT CODE:** ENG/OS/MAR/CR/08/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to operate and maintain ship control and automation systems. It involves monitoring and operating measuring instruments, maintaining and repairing automatic control system components, operating ship open loop control system, operating and maintaining ship sequential control systems, monitoring proportional-integral-derivative control systems performance, operating, maintaining and repairing manipulator elements, operating, maintaining and repairing signal transmitting components, installing and operating a monitoring system, preparing work schedule/maintenance plan, preparing work reports and installing, operating and updating monitoring system

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Monitor, measure, transduce and transmit measures parameters
 | * 1. Parameters to be measured and their limits are identified.
	2. Type of ***measuring instrument*** is identified as per SOPs
	3. Control signals and respective methods of transducing and transmission are identified
	4. Manufacturer manuals are obtained and reviewed based on the type of measuring instrument
	5. Working principles of measuring instruments are identified as per manufacturer’s manuals
	6. Measuring instruments are operated in line with manufacturer’s manuals
	7. Measuring instruments are maintained in line with manufacturer’s instructions and workplace policy
 |
| 1. Maintain and repair automatic control system components
 | * 1. Working principles of ***automatic control systems*** are identified as per manufacturer’s manuals
	2. Automatic control system components are identified in line with manufacturer’s manuals
	3. Faults in automatic control system components are identified as per SOPs
	4. Automatic control system components are maintained in line with manufacturer’s instructions and workplace policy
	5. Automatic control system components are repaired in line with manufacturer’s instructions and workplace policy.
	6. Maintenance reports are prepared.
 |
| 1. Operate, maintain and repair correcting units
 | * 1. Type of correcting unit is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of correcting unit
	3. Working principles of correcting unit are identified as per manufacturer’s manuals
	4. Correcting units are operated in line with manufacturer’s manuals
	5. Correcting units are maintained in line with manufacturer’s instructions and workplace policy
	6. Correcting units are repaired in line with manufacturer’s instructions and workplace policy
	7. Condition-monitoring and maintenance reports are prepared.
 |
| 1. Prepare work schedule/maintenance plan and methodology
 | * 1. Maintenance activities are identified based on the scope of maintenance
	2. Maintenance/work schedule is prepared based on maintenance activities identified
 |
| 1. Prepare work reports
 | * 1. Maintenance is carried out as per manufacturer’s specifications
	2. Condition-monitoring reports are prepared.
	3. Maintenance reports are prepared and maintained in line with workplace policy
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Measuring instrument May include but not limited to: | * Sensors
* Limit switch
* Meters
 |
| Automatic control system May include but not limited to: | * Process variable
* Desired value
* Control difference
* Control output
* Manipulating variable
* Manipulation range
* Sensors
* Actuators
* Analogue to digital converters
* Digital to analogue converters
* Input
* Output
* Open loop control system
* Closed loop control system
* Controller
* Controller logic
 |

**REQUIRED KNOWLEDGE**

* Measuring instruments
* Automatic control systems
* Ship open loop control system
* Ship sequential control systems
* Proportional-Integral-Derivative (PID) control systems
* Manipulator elements
* Signal transmitting components
* Monitoring systems
* Automation and Control softwares

**SKILLS**

* Communications
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* Multitasking
* First aid
* Report writing
* Surveying
* Software operation
* Coordinating
* Analytical
* Digital
* Critical thinking
* Reporting
* Teamwork and Personnel Management

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Demonstrated ability to monitor and operate measuring instruments
	+ Demonstrated ability to maintain and repair automatic control system components
	+ Operated open loop control system
	+ Demonstrated ability to operate and maintain ship sequential control systems
	+ Demonstrated ability to monitor PID control system performance
	+ Demonstrated ability to operate, maintain and repair manipulator elements
	+ Demonstrated ability to operate, maintain and repair signal transmitting components
	+ Demonstrated ability to install, update and operate a monitoring system
	+ Prepared work schedule/maintenance plan
	+ Prepared work reports
 |
| 1. Resource Implications
 | The following resources should be provided:* + Manufacturer operation and maintenance manuals
	+ Manufacturer electrical and electronic drawings
	+ Parts list
	+ Tools and equipment.
	+ Stationery
	+ Trained personnel
	+ Sensors
	+ Actuators
	+ Programmable Logic Controller (PLC)
	+ PLC simulator
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Interview
3. Assignment and completion of tasks
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# MAINTAIN MARINE TRANSMISSION, SHAFT AND PROPULSION SYSTEM

**UNIT CODE:** ENG/OS/MAR/CR/09/6/A

**UNIT DESCRIPTION**

This unit decribes competencies required to maintain marine transmission, shaft and propulsion system. It involves identifying working principles of gearboxes and propellers, identifying maintenance procedures of gearboxes, shafts and propellers, preparing spare parts list and special maintenance tools, preparing work schedule/maintenance plan, carrying out maintenance procedures and preparing work reports

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Identify working principles of gearboxes, shafts and propellers
 | * 1. Different types of gearboxes, shafts and propellers are reviewed from manufacturer’s manuals as per SOPs
	2. Operating principles and theories of different types of gearboxes, shafts and propellers are identified and applied in line with manufacturer’s specifications
	3. Functions of major components of gearboxes, shafts and propellers are identified from manufacturer’s manuals
	4. Gearbox, shaft and propeller specifications are interpreted as per SOPs
	5. Gearbox and control systems are identified.
	6. Shaft alignment principle is identified as per manufacturer’s manuals
 |
| 1. Identify maintenance procedures of gearboxes, shafts and propellers
 | * 1. Common faults of gearboxes, ***shafts*** and ***propellers*** and their remedies are reviewed from manufacturer’s manuals as per SOPs
	2. Maintenance procedures for common faults are reviewed from manufacturer’s manuals as per SOPs
	3. Maintenance and condition-monitoring records are reviewed as per SOPs.
	4. Maintenance procedures are carried out as per manufacturer’s specifications
	5. Maintenance reports are prepared as per workplace policy
 |
| 1. Prepare spare parts list and special maintenance tools
 | * 1. Manufacturer’s parts list manual is reviewed.
	2. Spare parts are identified and noted based on faulty gearbox, shaft and propeller parts to be replaced
	3. Special maintenance tools are identified based on manufacturer’s manuals
	4. Spare parts list and special maintenance tools are prepared in line with workplace policy
 |
| 1. Prepare work schedule/maintenance plan and work methodology
 | * 1. Maintenance activities are identified based on the scope of maintenance
	2. Work methodology is prepared
	3. Maintenance/work schedule is prepared based on maintenance activities identified
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Shaft include but not limited to: | * Alignment
* Bearings
* Lubrication system
* Coupling
 |
| Propeller include but not limited to: | * Propeller type
* Maintenance
 |

**REQUIRED KNOWLEDGE**

* Working principles of gearboxes, shafts and propellers
* Occupational Safety and Health
* Operation of transmission, shaft and propulsion systems
* Maintenance procedures
* Transmission, shaft and propulsion components
* Gearbox, shaft and propeller survey

**SKILLS**

* Communications
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* Multitasking
* First aid
* Report writing
* Surveying
* Software operation
* Coordinating
* Analytical
* Digital
* Critical thinking
* Reporting
* Teamwork and Personnel Management

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Identified working principles of gearboxes and propellers
	+ Identified maintenance procedures of gearboxes, shaft and propellers
	+ Prepared spare parts list and special maintenance tools
	+ Prepared work schedule/maintenance plan
	+ Carried out maintenance procedures
	+ Prepared Condition monitoring reports
	+ Interpreted drawings
	+ Identified coupling systems
 |
| 1. Resource Implications
 | The following resources should be provided:* + Manufacturer’s Operation and Maintenance Manuals
	+ Engineering Drawings
	+ Parts list
	+ Tools and equipment
	+ Gearboxes, shafts and propellers
	+ Workshop
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Interview
3. Assignment and Completion of tasks
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# OPERATE AND MAINTAIN NAVIGATION AND COMMUNICATION SYSTEMS

**UNIT CODE:** ENG/OS/MAR/CR/10/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to operate and maintain navigation and communication systems. It involves operating navigation and communication equipment, interfacing and synchronising navigation and communication equipment, preparing work schedule/maintenance plan, maintaining navigation equipment and preparing work report

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Operate navigation and communication equipment
 | * 1. ***Navigation and communication equipment*** to be operated are identified
	2. Working principles of navigation and communication equipment are identified based on manufacturer’s manual
	3. Navigation and communication equipment is operated in accordance with workplace and manufacturer operating procedures
	4. Navigation and communication equipment operating conditions are monitored and observed as per SOPs
	5. Deviations from normal operating conditions are detected as per SOPs
	6. Corrective actions are taken/reported in accordance with workplace policy and manufacturer manuals
 |
| 1. Interface and synchronize navigation and communication equipment
 | * 1. Navigation equipment to be synchronized are identified
	2. Navigation equipment to be synchronized are connected to a common unit.
	3. The parameters are monitored from a common display.
 |
| 1. Prepare work schedule/maintenance plan and methodology
 | * 1. Maintenance activities are identified based on the scope of maintenance
	2. Work methodology is prepared.
	3. Maintenance/work schedule is prepared based on maintenance activities identified
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Navigation and communication equipment include but not limited to: | * Radar
* GPS
* GPRS
* Gyro-compass
* Magnetic compass
* Echo sounder
* Speed log
* Barometer
* Wind vane
* Chart plotter (electronic)
* HF Radio
* VHF Radio
* Navigation lights
* ECDIS-Electronic Chart Display and Information Systems
* Medium Frequency Radio (MF Radio)
* SONAR (Sound Navigation Ranging)
 |

**REQUIRED KNOWLEDGE**

* Navigation and communication equipment onboard ships
* Operation of navigation and communication equipment
* Maintenance procedures

**SKILLS**

* Communications
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* Multitasking
* First aid
* Report writing
* Navigation

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Demonstrated ability to operate navigation and communication equipment
	+ Demonstrated ability to interface and synchronise navigation and communication equipment
	+ Prepared work schedule/maintenance plan
	+ Demonstrated ability to maintain navigation equipment
	+ Prepared work report
 |
| 1. Resource Implications
 | The following resources should be provided:* + Manufacturer’s operation and maintenance manual
	+ Spare parts list
	+ Electronic Drawings
	+ Tools and Equipment
	+ Stationery
	+ Trained personnel
	+ Navigation and communication equipment
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Interview
3. Assignment and Completion of tasks
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# ASSESS AND MONITOR MARINE AUXILIARY SYSTEMS

**UNIT CODE:** ENG/OS/MAR/CR/11/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to operate and monitor marine boiler systems and steam turbines and operating and maintaining refrigeration and air conditioning systems, heat exchangers and oil coolers, reverse osmosis plant and fresh water generation, storage and reticulation systems, ship steering system, ship stabiliser, anchor system, ship firefighting sytsem, ship ventilation system, sewerage and toilet/bathroom systems, bow thruster system, ship sea crane, ship visor door and ramp system and operaitng and maintaining main gallery equipment

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Operate and monitor marine boiler systems and steam turbines
 | * 1. Type of ***marine boiler system*** and steam turbine is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of marine boiler and steam turbine
	3. Working principles of marine boiler system and steam turbine are identified as per manufacturer’s manuals
	4. Marine boiler and steam turbines are operated in line with manufacturer’s manuals
	5. Marine boiler and steam turbines are monitored in line with manufacturer’s instructions and workplace policy
	6. Condition monitoring reports are prepared
 |
| 1. Operate and maintain HVAC (Heating Ventilation and Air Conditioning) systems
 | * 1. Type of refrigeration and ***air conditioning*** is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of refrigeration and air conditioning
	3. Working principles of refrigeration and air conditioning are identified as per manufacturer’s manuals
	4. Refrigeration and air conditioning are operated in line with manufacturer’s manuals
	5. Refrigeration and air conditioning are maintained in line with manufacturer’s instructions and workplace policy
	6. Maintenance and Condition monitoring reports are prepared
 |
| 1. Operate and maintain heat exchangers and oil coolers
 | * 1. Type of ***heat exchangers*** and oil coolers is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of heat exchangers and oil coolers
	3. Working principles of heat exchangers and oil coolers are identified as per manufacturer’s manuals
	4. Heat exchangers and oil coolers are operated in line with manufacturer’s manuals
	5. Heat exchangers and oil coolers are maintained in line with manufacturer’s instructions and workplace policy
	6. Maintenance and Condition monitoring reports are prepared
 |
| 1. Operate and maintain reverse osmosis plant and fresh water generation, storage and reticulation systems
 | * 1. Type of reverse osmosis system is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of reverse osmosis system
	3. Working principles of reverse osmosis system are identified as per manufacturer’s manuals
	4. Reverse osmosis systems are operated in line with manufacturer’s manuals
	5. Reverse osmosis systems are maintained in line with manufacturer’s instructions and workplace policy
	6. Maintenance and Condition monitoring reports are prepared
 |
| 1. Operate and maintain ship steering system
 | * 1. Type of ***ship steering gear system*** is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of ship steering gear system
	3. Working principles of ship steering system are identified as per manufacturer’s manuals
	4. Ship steering system are operated in line with manufacturer’s manuals
	5. Ship steering system are maintained in line with manufacturer’s instructions and workplace policy
	6. Maintenance and Condition monitoring reports are prepared
 |
| 1. Operate and maintain ship stabilizer
 | * 1. Type of ***ship stabilizer system*** is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of ship stabilizer system
	3. Working principles of ship stabilizer system are identified as per manufacturer’s manuals
	4. Ship stabilizer system are operated in line with manufacturer’s manuals
	5. Ship stabilizer system are maintained in line with manufacturer’s instructions and workplace policy
	6. Maintenance and Condition monitoring reports are prepared
 |
| 1. Operate and maintain anchor system
 | * 1. Type of ***ship anchor system*** is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of ship anchor system
	3. Working principles of ship anchor system are identified as per manufacturer’s manuals
	4. Anchor system is operated in line with manufacturer’s manuals
	5. Anchor system is maintained in line with manufacturer’s instructions and workplace policy
	6. Maintenance and Condition monitoring reports are prepared
 |
| 1. Operate and maintain ship firefighting system
 | * 1. Fire triangle, types of fire and method of detection and extinguishing are identified
	2. Type of ship firefighting system is identified as per SOPs
	3. Manufacturer manuals are obtained and reviewed based on the type of ship firefighting system
	4. Working principles of ship firefighting system are identified as per manufacturer’s manuals
	5. Ship firefighting system are operated in line with manufacturer’s manuals
	6. Ship firefighting system are maintained in line with manufacturer’s instructions and workplace policy
	7. Maintenance and Condition monitoring reports are prepared
 |
| 1. Operate and maintain sewage and toilet/ bathroom systems
 | * 1. Maritime regulations on waste treatment and disposal are identified
	2. Type of sewage and toilet/ bathroom systems is identified as per SOPs
	3. Manufacturer manuals are obtained and reviewed based on the type of sewage and toilet/ bathroom systems
	4. Working principles of sewage and toilet/ bathroom systems are identified as per manufacturer’s manuals
	5. Sewage and toilet/ bathroom systems are operated in line with manufacturer’s manuals
	6. Sewage and toilet/ bathroom systems are maintained in line with manufacturer’s instructions and workplace policy
	7. Maintenance and Condition monitoring reports are prepared
 |
| 1. Operate and maintain bow thruster system
 | * 1. Type of bow thruster system is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of bow thruster system
	3. Working principles of bow thruster system are identified as per manufacturer’s manuals
	4. Bow thruster system are operated in line with manufacturer’s manuals
	5. Bow thruster system are maintained in line with manufacturer’s instructions and workplace policy
	6. Maintenance and Condition monitoring reports are prepared
 |
| 1. Operate and maintain ship sea crane
 | * 1. Type of ship sea crane is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of ship sea crane
	3. Working principles of ship sea crane are identified as per manufacturer’s manuals
	4. Ship sea crane are operated in line with manufacturer’s manuals
	5. Ship sea crane are maintained in line with manufacturer’s instructions and workplace policy
	6. Maintenance and Condition monitoring reports are prepared
 |
| 1. Operate and maintain ship visor door and ramp system
 | * 1. Type of ship visor door and ramp system is identified as per SOPs
	2. Manufacturer manuals are obtained and reviewed based on the type of ship visor door and ramp system
	3. Working principles of ship visor door and ramp system are identified as per manufacturer’s manuals
	4. Ship visor door and ramp system are operated in line with manufacturer’s manuals
	5. Ship visor door and ramp system are maintained in line with manufacturer’s instructions and workplace policy
	6. Maintenance and Condition monitoring reports are prepared
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Marine boiler system include but not limited to: | * Composite boiler
* Radiant-type boiler
* Reheat boiler
* Double evaporation boiler
* ESD II and ESD III type boiler
 |
| Air conditioning include but not limited to: | * Evaporative air conditioners
* Refrigerant air conditioners
 |
| Heat exchangers include but not limited to: | * Plate
* Shell and tube
 |
| Ship steering gear system include but not limited to: | * Hydraulic
* Electro-hydraulic type
 |
| Ship stabiliser system include but not limited to: | * Bow thrusters
* Fin stabilisers and stabilising systems
* Folding fin stabiliser
* Retractable fin stabiliser
* Tank stabilisers
* Sea keeper
 |
| Ship anchor system include but not limited to: | * Stockless
* BBI-Delta
* Kedge Admiralty
 |

**REQUIRED KNOWLEDGE**

* Refrigeration and Air Conditioning
* Hydraulics and Pneumatics
* Boiler Technology
* Plumbing
* Crane Operation
* Electromechanical Systems

**SKILLS**

* Communications
* ICT
* Time management
* Problem solving
* Decision making
* Planning
* Multitasking
* First aid
* Report writing
* Surveying
* Team Work
* Personnel Management
* OSHE

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Demonstrate ability to operate and maintain boiler systems and steam turbines
	+ Demonstrated ability to operate and maintain refrigeration and air conditioning systems
	+ Demonstrated ability to operate and maintain HVAC systems
	+ Demonstrated ability to operate and maintain reverse osmosis plant and fresh water generation, storage and reticulation systems
	+ Demonstrated ability to operate and maintain ship steering system
	+ Demonstrated ability to operate and maintain ship stabilizer
	+ Demonstrated ability to operate and maintain anchor system
	+ Demonstrated ability to operate and maintain ship firefighting system
	+ Demonstrated ability to operate and maintain sewage and toilet/ bathroom systems
	+ Demonstrated ability to operate and maintain bow thruster system
	+ Demonstrated ability to operate and maintain ship sea crane
	+ Demonstrated ability to operate and maintain ship visor door and ramp system
 |
| 1. Resource Implications
 | The following resources should be provided:* + Manufacturer’s manuals
	+ Engineering Drawings
	+ Parts List
	+ Tools and Equipment
	+ Auxiliary systems or simulator
	+ Workshop
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Interview
3. Assignment and Completion of tasks
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# MANAGE MARINE ORGANISATION

**UNIT CODE:** ENG/OS/MAR/CR/12/6/A

**UNIT DESCRIPTION**

This unit describes competencies required to manage marine organisation. It involves designing office operations, managing public relations, managing human resource, conducting on board training, designing job specifications, managing conflicts, implementing procurement procedures, carrying out emergency drills, performing PMO operations, coordinating workshop operations, performing quality control and quality assurance, applying occupational safety, health and environment procedures and performing MCR and engine room watchkeeping

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Manage public relations
 | * 1. Public Relations activities are identified in accordance with the strategic plan.
	2. PR resources are determined according to PR activities
	3. Public Relations activities are carried out in accordance with PR Policy and Procedures.
	4. PR activities are analysed and reviewed as per PR policy and procedures
 |
| 1. Manage human resource
 | * 1. Human resource policy is developed as per SOPs
	2. Human resource planning is undertaken based on the strategic plan
	3. Human resource is recruited based on organisation’s human resource needs
	4. Human resource training and development is coordinated according to the human resource policy
	5. Human resource is monitored and appraised as per human resource policy
 |
| 1. Conduct on-board training
 | * 1. Training needs are identified based on workplace policies and organisation’s strategic plan
	2. Training tools, equipment and materials are identified and obtained in line with the training needs
	3. On-board training schedule is developed based on training needs identified
	4. On-board training is carried out in line with organisation policy
 |
| 1. Design job specifications
 | * 1. Organisation’s scope of works is analysed as per SOPs and strategic plan
	2. Human resource needs are identified based on the scope of works
	3. Job specifications for positions are established based on the human resource needs and scope of works
 |
| 1. Implement procurement procedures
 | * 1. Organisations goods and services are procured in line with procurement policy
	2. Procured goods are warehoused in line with procurement policy
	3. Stored goods are distributed according to workplace policies
	4. Organisation’s assets are disposed in line with procurement policy
 |
| 1. Carry out emergency drills
 | * 1. Fire ***emergency drills*** are carried out
	2. Damage Control Emergency Drills are carried out on board
	3. Machinery failure emergency drills are carried out on board and in the workshop
 |
| 1. Coordinate workshop operations
 | * 1. Workshop is set up based on workshop operations
	2. Workshop is operationalised in line with workplace policy
	3. Workshop floor operations are managed according to workplace policies
	4. Workshop stock are procured and controlled as per procurement policy
	5. Workshop plant is maintained as per SOPs
	6. Workshop database is maintained in line with organisation policy
	7. Safety Health and Environment inductions are carried out
 |
| 1. Perform quality control and quality assurance
 | * 1. Quality standards and product requirements are outlined in line with workplace policies
	2. Objective inspection criteria are established according to quality requirements
	3. Quality inspection checklist is prepared based on quality standards and product requirements
	4. Quality inspection is carried out as per SOPs
	5. Quality inspection report is prepared and disseminated in line with workplace policy
 |
| 1. Apply Occupational Safety, Health and Environment (OSHE) Procedures
 | * 1. Information to work team about company OSHE program, procedures and policies/guidelines are provided.
	2. Implementation of OSHE procedures and policies/ guidelines are participated.
	3. Team members are trained and advised on OSHE standards and procedures.
	4. Procedures for maintaining OSHE-related records are implemented.
 |
| 1. Perform MCR and engine room watch keeping
 | * 1. Tasks to be carried out during watch keeping are identified
	2. Parameters to be monitored during watch keeping are identified
	3. Watch keeping reporting procedure are carried out.
 |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| Emergency drills include but not limited to: | * Firefighting
* Damage control
* Machinery failure
 |

**REQUIRED KNOWLEDGE**

* Design office Management
* Public Relations Management
* Human Resource Management
* Conflict Management
* Procurement and Logistics Management
* Maintenance Planning
* Workshop Management
* Quality control and quality assurance Management
* Apply Occupational Safety, Health and Environment (OSHE) Management

**SKILLS**

* Planning
* Coordination
* Budgeting
* Design

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate* + Demonstrated ability to design office operations
	+ Demonstrated ability to manage public relations
	+ Demonstrated ability to manage human resource
	+ Conducted on board training
	+ Designed job specifications
	+ Demonstrated ability to manage conflicts
	+ Demonstrated ability to implement procurement procedures
	+ Carried out emergency drills
	+ Performed PMO Operations
	+ Coordinated workshop operations
	+ Demonstrated ability to perform quality control and quality assurance
	+ Applied Occupational Safety, Health and Environment (OSHE) Procedures
	+ Performed MCR and engine room watch keeping
 |
| 1. Resource Implications
 | The following resources should be provided:* + Trained personnel
	+ Drawing papers
	+ Drawing tools and equipment
	+ Marine organisation
 |
| 1. Methods of Assessment
 | Competency may be assessed through:1. Written text
2. Interview
3. Assignment and completion of tasks
4. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |